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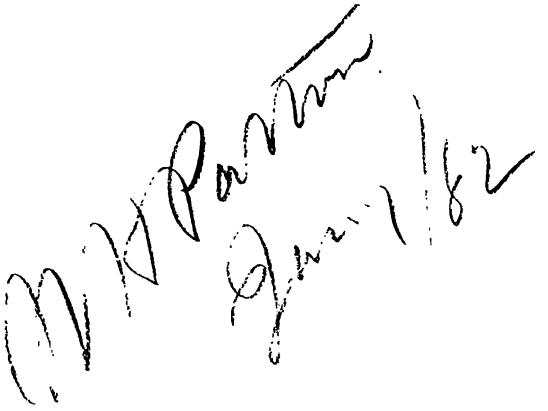

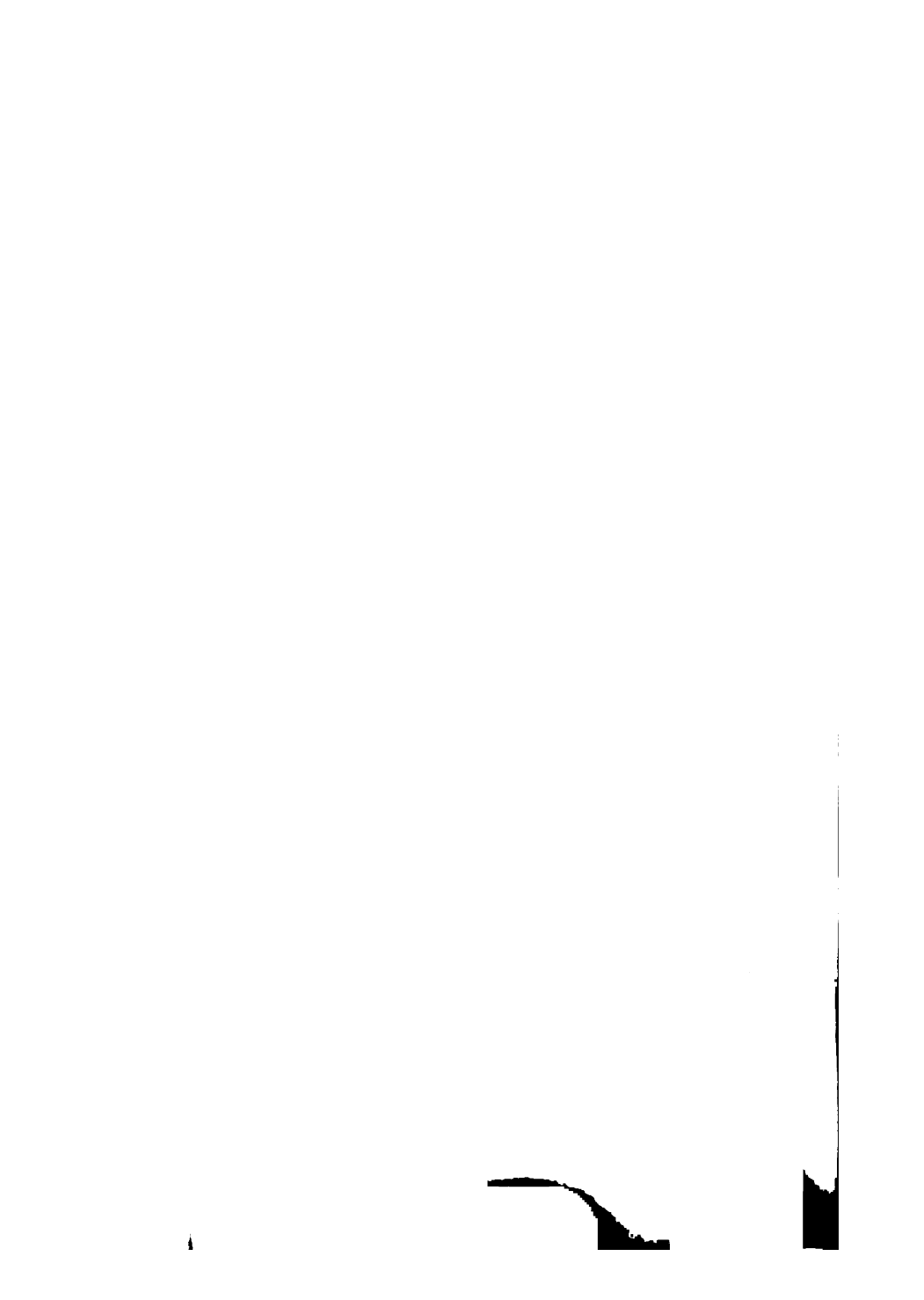

TRANSFUSION

OF

HUMAN BLOOD

TRANSFUSION

OF

HUMAN BLOOD

BY THE METHOD OF

J. ROUSSEL (OF GENEVA)

DOCTOR OF THE FACULTY OF MEDICINE OF PARIS,
KNIGHT OF THE ORDERS OF
ST. WLADIMIR OF RUSSIA, FRANZ-JOSEF OF AUSTRIA,
LEOPOLD OF BELGIUM

WITH A PREFACE BY

SIR JAMES PAGET, BART., F.R.S.

SERJEANT-SURGEON TO THE QUEEN

TRANSLATED FROM THE FRENCH AND GERMAN BY

C. H. C. GUINNESS, B.A.

LATE SCHOLAR OF NEW COLLEGE, OXFORD

LONDON
J. & A. CHURCHILL, NEW BURLINGTON STREET
1877

"Natura non nisi parendo vincitur."
Bacon.

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1877

PREFACE

Dr Roussel having expressed a wish that I should introduce to English readers the translation of his work on Transfusion of Blood, I venture to say that it seems to me to deserve careful study.

The apparatus which he has invented and which is here described, fulfils better than any other known to me, the conditions requisite for the transfusion of pure blood unchanged *in transitú*. With its help transfusion may safely be performed by any one competent to practise surgery.

It may be hoped that the greater facility and safety of the operation may add to its more frequent performance, in the cases of peril of death from hæmorrhage.

In these, the utility of transfusion has long

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been established beyond doubt, and now one cannot but hope that it may prove very useful, in some cases of impaired and deficient blood due to disease. Certainly it deserves trial in these cases, and I cannot doubt that Dr Roussel is justified in urging its use.

As to any damage to be sustained by the person who gives blood for transfusion, no fear of this can be felt by any one who, like myself, many years ago, bled healthy people in any number without harm. To a healthy person the loss of a few ounces of blood by venesection is, I believe, absolutely harmless.

JAMES PAGET.

CONTENTS

	PAGE
Preface, by Sir James Paget	v
Introduction	1
Historical Résumé—Transfusion in Ancient Times	5
The Methods observed in Transfusing by Richard Lower (1665)	13
The Quaeries and Tryals proposed by Robert Boyle (1667)	16
Transfusion in Modern Times	22
Critical Notes upon various Methods	27
Injection of Defibrinated Blood	28
Indirect or Instantaneous Transfusion,—Mathieu's Apparatus	28
Direct Transfusion through a Closed Tube-Channel	31
Arterial Transfusion of Animal Blood	33
Direct Venoso-venous Transfusion	34
Roussel's Method	37
Conditions of the Transfusion	39
Employment of Water to expel the Air	40
Medicated Transfusion	40
Transfusion with Electricity	40
Temporary Ischæmia	41
Depletive Bleeding	41
Preparation of the Vein of the Patient	42

PAGE

Roussel's Transfuser (*illustration*) . . . 44
Résumé of the Stages of the Direct Transfusion . . 45
Amount to be Transfused 50
Phenomena ensuing after the Transfusion . . . 50
Transfusions in Surgical Cases 54
In Puerperal Hæmorrhage (Geneva) . . . 54
In Chronic Anæmia and Hæmorrhage (St Petersburg) . 57
In Surgical Chronic Anæmia (London) . . . 59
Transfusions in Medical Cases 67
In Chronic Chloro-Anæmia (Cronstadt) . . . 67
In Hæmophilia (Paris) 70
In Pulmonary Consumption (Geneva) . . . 74
In Melancholic Dementia (Vienna) 78
In long-standing Dementia with Anæmia (London) . 82
Table of Fifty Transfusions performed by Dr. Roussel . 89

TRANSFUSION

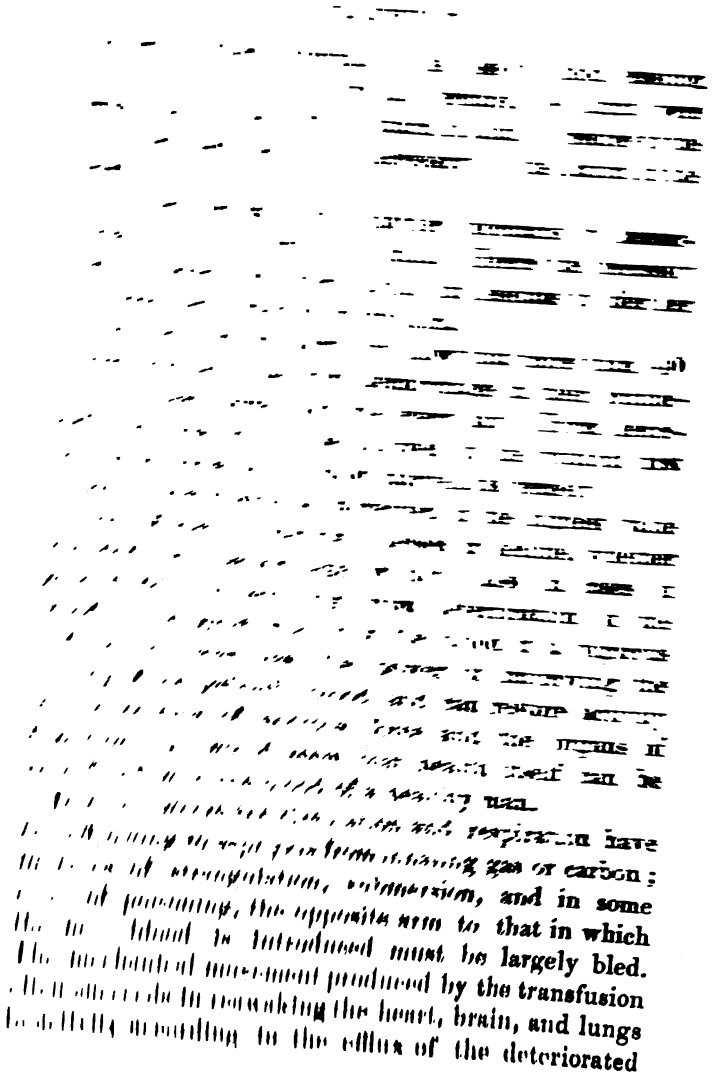
OF

HUMAN BLOOD

INTRODUCTION

TRANSFUSION of blood is a subject possessing interest for the whole body of those devoted to the art of healing, who should all be capable of performing the operation in urgent cases without hesitation. Above all, it is necessary that the operator should be enabled, without delay, to find blood to transfuse. Hence the necessity (not general in the case of surgical operations) that the public should have some notion of the subject of transfusion, since every one may be called upon, by giving a few ounces of his blood, to restore life to a brother or a friend suffering, it may be, from the cutting of an artery, which can happen by any ordinary accident.

This would more frequently occur in times of war, because few of war's victims are killed outright. The



[illegible]

[illegible] respiration have [illegible] gas or carbon; [illegible] strangulation, submersion, and in some [illegible] poisoning, the opposite arm to that in which [illegible] is introduced must be largely bled. The mechanical movement produced by the transfusion [illegible] in rewarming the heart, brain, and lungs [illegible] according to the efflux of the deteriorated

blood on the one side, and the influx of the healthy blood on the other.

It is absolutely necessary that the public should understand—that the loss of nine or ten ounces of blood at a time is a wholly insignificant loss to the vigorous body of an adult, who possesses in all from fourteen to fifteen kilogrammes; that the trifling wound produced by the lancet on the vein of the arm gives no pain, and is always healed in forty-eight hours; finally, that the health of the person from whom the blood is taken is not impaired at any period by the operation, as the blood is entirely restored in one day after two good meals. Fifty years ago the practice of bleeding was undoubtedly abused in nearly all maladies, and in consequence of its abuses it is now absolutely rejected where in many cases it might be beneficial. There is no reason why persons in perfect health should fear the loss of a few ounces of blood.

It is desirable that the public should know that though ten ounces of blood is no serious loss to a vigorous man, they yet are sufficient in most cases to resuscitate the dying man who has lost many kilogrammes. The fact is that the heart ceases to beat long before all the blood is expended; the hæmorrhage ceases, but death ensues nevertheless.

The heart, just as is the case with a pump, requires the liquid to attain a certain height in order that it may act; a few ounces less than the minimum amount will be enough to stop it, whereas if these few ounces are supplied and the minimum surpassed the heart recommences its action.

The patient who has undergone the operation is

doubtless very weak; it is true he has very little store of blood remaining; but after all he is not *dead*, and death is the only state which knows no remedy.

If Christian charity and the devotion of man to man be not mere empty phrases, if the progress of science be not a mere expression, before this year shall have reached its close it is to be hoped that all surgeons, both military and civil, all accoucheurs and all practitioners, will have accepted and adopted the practice of transfusion, while every adult and healthy man and woman should be ready to come forward to offer their arm as the natural and mysteriously inexhaustible source of the wonder-working elixir.

"For the blood is the life."—Deuteronomy, xii, 23.

HISTORICAL RÉSUMÉ

ENGLAND may with justice claim to be the native land of transfusion, from a scientific point of view. It was publicly demonstrated for the first time at the Royal Society of London, in the May meeting, 1665, by Richard Lower, of Oxford, and Robert Boyle.

Historically speaking it is as ancient as the history of medicine itself.

To bestow blood on a man who is dying from having lost too much, or to replace by healthy and youthful blood that which disease or age has impaired, seems to be so logical a process and practically so easy of execution, that human ingenuity had seized upon the idea from the very infancy of the world, or at least from the very earliest ages of medical science.

Transfusion in Ancient Times.—The Egyptians, the Hebrews, and the Syrians used to practise transfusion; their writers have mentioned it.

Naaman, chief leader of the army of Ben-Habad, king of Syria, being seized with leprosy, his physicians, in order to cure him, took the blood out of his veins and replaced it with other blood.

Herophilus, Tanaquilla in the time of Tarquinius

Priscus, the books of the Eubages, those of the priests of Apollo, Plinius, Celsus, Libavius, &c., all mention the process.

Ovid in the 'Metamorphoses,' lib. viii, makes Medea say:

> " . . . . . quid nunc dubitatis inertes?
> " Strangite, ait, gladios veteremque haurite cruorem
> " Ut repleam vacuas juvenili sanguine venas."

Fabricius of Aquapendente, Marcello, Ficinus, Trithemus, Harvée, Fra Paolo, speak of having witnessed the operation.

The list of persons known to have undergone transfusion begins with no less a personage than Pope Innocent VIII, April, 1492.

Villari, in the life of Jerome Savonarola, 'Ecclesiasticæ Annales,' 1492 (Raynaldi), asserts that the pope appeared to be dying, and that a Jewish physician endeavoured to prolong his life by giving him the blood of three young men successively. No effect was produced on the pope, but the three young men died.

The historian and some modern physicians infer that the deaths were caused by the intrusion of air into the veins, but it seems to me more probable that the operator simply attempted direct arterial transfusion by attaching a tube to the carotid artery of the young men, who died of hæmorrhage in consequence; and the fact that no change was observed in the pope's condition proves to me that he really received no blood, or very little if any, because the apparatus, or even the vein itself, was obstructed with clots, and thus the penetration of the blood was prevented. It was

doubtless because the blood could not be made to pass that the operation was repeated three times.

Similar results were frequent in those days, and still are produced when the direct transfusion with the arterial blood of animals is attempted.

It is the same process of direct arterial transfusion which is described by Libavius of Halle, professor at the school of Coburg in 1615, in his *Appendix necessaria synagmatis arcanorum chymicorum* (Francoforti, 1615, chap. ix):

"Adsit juvenis, robustus, sanus, sanguine spirituoso plenus; adstet exhaustus viribus, tenuis, macilentus, vix animam trahens. Magister artis habeat tubulos argenteos, inter se congruentes, aperiat arteriam robusti et tubulum inserat, muniatque; mox et ægroti venam findat et tubulum fœmineum infingat, jam duos tubulos sibi mutuo applicet, et ex sano sanguis arterialis, calens et spirituosus saliat in ægrotum, unàque vitæ fontem afferet, omnemque languorem pellet."

This, again, is the same direct arterial transfusion with the same two silver tubes which the advocates of the transfusion of sheep's blood to man still practise in Germany and Italy, being less advanced, physiologically at least, than the Jewish physicians of the fifteenth century, who used to transfuse to man blood taken from his own species.

William Harvey's splendid discovery of the circulation of the blood inspired Francesco Folli of Firenze, in 1652, with the project of performing direct transfusion by a method which should have been the starting-point of extraordinary progress, were it not true of former times, as it is of our own, that great discoveries

are doomed to suppression under the silence of inactive routine.

Folli proposed to attach a silver canula to the artery and a canula made of bone to the vein, and to connect them by a portion of an animal's artery, so prepared as to have a tube branching from its side, by which the air contained within could escape. This is an almost perfect apparatus. Folli knew already in 1652 what I am still obliged to repeat every day to new opponents; viz. that if the blood encounters any air in the apparatus it coagulates, and obstructs the apparatus, and that this blood if once touched by the air, loses its vitality at once, and is injurious to the patient who receives it.

Had Folli's colleagues and fellow countrymen encouraged and imitated him, transfusion would long since have become a classical operation, and the honour would belong to Italy.

In France they had not dared practise arterial transfusion, because in opening the carotid artery of the blood-giver his life was inevitably sacrificed. In 1653 Robert des Gabets, a monk of Cluny, demonstrated the possibility of performing intra-venous transfusion, which he designated *communication*, by means of two little silver tubes which he had manufactured at Mâcon in 1651, under the direction of another monk, Dom Eloy Pichot. These tubes were connected by a leather ball the size of a walnut, and each contained a valve to regulate the flow of the blood. By compressing the ball the necessary force was communicated to the venous blood to make it penetrate, and the quantity of blood transfused could be measured.

Many apparatus recently brought out as novel are really constructed on this model, which was executed in 1651.

In Germany, in 1664, a work appeared by Major Jean Daniel, a physician at Leipsig, entitled "*Prodroma a se inventæ chirurgæ infusoriæ sive quo pacto ægri curantur,*" in which he describes a complete process, which he had employed for some time previously, for transfusing into the veins of a sick person the blood of a healthy man. He used to put some salts of ammonia in the apparatus in order to prevent the coagulation of the blood. Some authors of the present day still assert the value of mingling the same substance with the blood with the same end in view.

In France, in 1667, Denys, professor of philosophy, who had read the letter from Richard Lower, of Oxford, to Robert Boyle, of the Royal Society of London, tried the experiment with his surgeon, Emmeretz. Following step by step the process of Richard Lower, they succeeded so well several times in restoring, by transfusion, dogs which had been bled to death, that they decided to try the experiment on man. The first transfusion was performed at Paris, on a boy aged sixteen, who had remained in a state of stupor and somnolence in consequence of a fever which had lasted two months, during the course of which he had been bled twenty times. Emmeretz and Denys drew three ounces more of blood from him, and transferred to him nine ounces of arterial sheep's blood. After a somewhat grave attack of congestion, in which the patient lost blood by the nose, he calmed down, and gradually mended till the cure was effected.

Elated by this success, the operators renewed their experiments on several patients, one being a furious madman; another a street porter, who submitted to the operation for a crown; and, with a little want of discretion, in the case of a man suffering from gangrene in the intestine, to whom transfusion could avail nothing.

As is always the case with innovators, they were jealously watched by numerous adversaries, and a terrible outcry was raised against them on all sides, especially by an individual named La Martinière, who is otherwise unknown, while on all sides quite a dictionary of abuse of a most unscientific nature was exhausted upon them.

Denys and Emmeretz belonged to the faculty of Montpelier, and on coming to Paris had all the physicians of the Parisian faculty ranged against them, and yielded to the force of numbers.

Next ensued a judgment of the criminal judge of Chatelet respecting an inquest upon a death, of causing which Denys was accused. The decision proves that Denys had nothing to do with the death; but in conclusion, the judge said that "in future transfusion may not be performed on a human subject without the permission of a doctor of Paris. April 17th, 1668."

Now, the Parisian doctors were opposed to transfusion because they were unable to perform it; consequently transfusion was abandoned, and lay forgotten for more than 150 years.

I trust that the like misfortunes are impossible in these days; but there are always La Martinières in the world.

William Harvey, the Englishman, during his studies at Padua in 1604, under the direction of Girolamo Fabrizzio of Aquapendente, was engaged on the subject of the venous valvules, which had already been discovered in the 15th century by Theodoretus, bishop of the town of Cyra, in Syria, who says in his third discourse, "*Venas tenuissimis tunicis vestivit deus et orificiis earum exilia opercula addidit.*"

On returning to London in 1616, Harvey commenced his works, published in 1628, "*De motu cordis et sanguinis in animalibus,*" and proved the centripetal motion of the blood in the veins, from the extremities of the limbs and from all the organs towards the heart, which is termed the Harveian circulation, or great circulation.

What we still term the lesser circulation, viz. that of the blood from the heart to the lungs, and from the lungs to the heart, had already been in part surmised by Aristotle, and by the Alexandrian School under Herophilus of Chalcedon, and Eristratus of Chios, 500 B.C. This theory, however, was obscured by grave mistakes which Claudius Galenus, 131 A.D., and, later on, André Vesalis had in part elucidated.

It was completely and clearly demonstrated at Geneva in 1553, by Michael Servet, who, in his treatise, "*Christianismi restitutio,*" says, in speaking of the sanguineous current between the two cavities of the heart:

"*Fit autem communicatio hæc, non per parietem cordis medium, ut vulgo creditur, sed magno artificio a dextro cordis ventriculo, longo per pulmones ductu agitatur sanguis subtilis; a pulmonibus præparatur, flavus efficitur, et a vena arteriosa in arteriam venosam transfunditur.*"

At Geneva then, as is unfortunately still the case, religious antipathies and quarrels had precedence over scientific questions, and in 1553 the fanatic Calvin, who pretended to combat the fanaticism of Rome, condemned Michael Servet to death as a heretic, and had him burnt alive at the stake, thus stifling in the roar of its pitiless flames the torch of science which was beginning to illumine Geneva, and would, perhaps, have conferred on my own country the glory of that discovery which England to-day claims with pride as her own.

Religious fanaticism in our days no longer dares at Geneva to make use of the stake: its weapons now are exile and calumny; from murder it has turned to robbery; and under the pretext of liberty it suppresses and confiscates to its own profit free hospitals in which I once was able to work unmolested, without provoking the jealousy of official cliques.

Harvey had dedicated his work to King Charles I, whose physician he was. He followed the king to Oxford during the civil war, and, not relaxing his devotion to science, founded with Bishop John Wilkins a society of savans under the title of the College of Philosophers.

When Oxford fell into the hands of the Parliamentary troops, and King Charles had been beheaded under the windows of his own palace, the College removed itself to London, and, on the accession of Charles II, who himself was a patron of natural science, was permanently established and received from the king the name of the "*Royal Society*," 1662.

He commenced the uninterrupted publication of the 'Philosophical Transactions,' which register all the

labours of the society's members, and preserve to us the precious text of Harvey's discoveries, as well as those of Richard Lower, Robert Boyle, &c. This gives to England the honour of possessing the first authentic documents on transfusion, while in other countries the labours of savans were lost for the most part, or were only partially preserved in oral traditions, which are uncertain and insufficient.

In England, Harvey, in proving the reality of the circulation of the blood in man, had opened the scientific road to the circulation of blood from one man to another.

Shortly afterwards Christopher Wren proposed the infusion of liquid medicaments into the veins, which borders very closely on transfusion of natural blood, the most effective medicament of all.

In 1665 Richard Lower, professor at Oxford, wrote to Robert Boyle, President of the Royal Society of London, the famous letter on transfusion of blood with the process of operation already employed at Oxford minutely described. This is the first authentic scientific document upon the operation which we possess (*vide* 'Philosophical Transactions,' vol. i, Monday, December 17, 1666, page 353).

"*The method observed in transfusing the blood out of one animal into another.*—The method was promised in the last of these papers. It was first practised by Doctor Lower in Oxford, and by him communicated to the Honorable Robert Boyle, who imparted it to the Royal Society as follows:

"First take up the carotidal artery of the dog or other animal whose blood is to be transfused into

another of the same or a different kind, and separate it from the nerve of the *eighth paire*, and lay it bare above an inch.

" Then make a strong ligature on the upper part of the artery, not to be untied again; but an inch below, videl. towards the heart, make another ligature of a *running* knot, which may be loosened or fastened as there shall be occasion.

" Having made these two knots, draw two threads under the artery between the two ligatures, and then open the artery and put in a quill, and tie the artery upon the quill very fast by those two threads, and stop the quill with a stick. After this make bare the jugular vein in the other dog about an inch and a half long, and at each end make a ligature with a running knot, and in the space betwixt the two running knots draw under the vein two threads as in the other. Then make an incision in the vein, and put into it two quills, one into the *descendent* part of the vein to receive the blood from the other dog and carry it into the heart, and the other quill put into the other part of the jugular vein which comes from the head (out of which the second dog's own blood must run into dishes).

" These two quills being put in and tyed fast, stop them with a stick till there is occasion to open them.

" All things being thus prepared, tie the dogs on their sides towards one another, so perfectly that the quills may go into each other (for the dogs' necks cannot be brought so near but that you must put two or three several quills more into the first two to convey the blood from one to another).

"After that unstop the quill that goes down into the first dog's *jugular* vein and the other quill coming out of the other dog's artery, and by the help of two or three other quills put into each other according as there shall be occasion, insert them into one another. Then slip the running knots, and immediately the blood runs through the quills as through an artery, very impetuously. And immediately as the blood runs into the dog unstop the other quill, coming out of the *upper* part of the *jugular* vein (a ligature being first made about his neck, or else his other jugular vein being compress'd by one's finger), and let his own blood run out at the same time into dishes (yet not constantly, but according as you perceive him able to bear it, till the other dog begins to cry and faint and fall into convulsions, and at last dye by his side).

"Then take out both the quills out of the dog's jugular vein and tye the running knot fast and cut the vein asunder (which you may doe without any harm to the dog, one jugular vein being sufficient to convey all the blood from the head and upper part by reason of a large anastomosis, whereby both the *jugular* veins meet about the larynx). This done, sew up the skin and dismiss him, and the dog will leap from the table and shake himself and run away as if nothing ailed him.

"There are many circumstances necessary to be observed in the performing of this experiment. . . . *Secondly*, that you constantly observe the *pulse* beyond the quill in the dog's *jugular* vein (which it acquires from the impulse of the *arterious* blood). For if that fails, then 'tis a sign the quill is stopt by some con-

gealed blood, so that you must draw out the arterial quill from the others, and with a *probe* open the passage again in both of them, that the blood may have its free course again. For this must be expected when the dog that bleeds into the other hath lost much blood his heart will beat very faintly, and then, the impulse of the blood being weakened, it will be apt to congeal the sooner, so that at the latter end of the work you must draw out the quill often and clear the passage. . . . The most probable use of this experiment may be conjectured to be that one animal may live with the blood of another, and consequently that those animals that want blood or have corrupt blood may be supplyed from others with a sufficient quantity, and of such as is good, provided the transfusion be often repeated, by reason of the quick expense that is made of the blood."

"*Tryals proposed by Mr Boyle to Dr Lower to be made by him for the improvement of transfusing blood out of one live animal into another.* ('Philosophical Transactions,' Monday, February 11, 1667, page 385, vol. i.)

"The following *quaeries* and *tryals* were written long since, and read about a month ago in the Royal Society, and so now come forth against the author's intention, at the earnest desire of some learned persons, and particularly the worthy doctor, to whom they were addressed, who thinks they may excite and assist others in a matter which to be well prosecuted will require many hands. At the reading of these the author declared that of divers of them he thought he could foresee the events, but yet judged it fit not to omit them, because the importance of the *theories* they may

give light to may make the trials recompense the pains, whether the success favours the *affirmative* or the *negative* of the question, by enabling us to determine the one or the other upon surer grounds than we could otherwise do. And this advertisement he desires may be applied to those other papers of his that consist of quæries or proposed tryals."

The quæries themselves follow:

"1. Whether by this way of transfusing blood the disposition of individual animals of the same kind may not be much altered (as whether a *fierce* dog, by being often quite new stocked with the blood of a *cowardly* dog may not become more tame, or *vice versâ*).

"2. Whether immediately upon the unbinding of a dog, replenisht with adventitious blood, he will know and fawn upon his master, and do the like customary things as before; and whether he will do such things better or worse at some time after the operation.

"3. Whether those dogs that have peculiarities will have them either abolished or at least much impaired by transfusion of blood.

"4. Whether acquired habits will be destroyed or impaired by this experiment.

"5. Whether any considerable change is to be observed in the pulse, urine, and other excrements of the recipient animal by this operation, or the quantity of his insensible transpiration.

"6. Whether the *emittent* dog being full fed at such a distance of time before the operation that the mass of blood may be supposed to abound with *chyle*, the *recipient* dog being before hungry will lose his appetite,

to prosecute the study. I should, however, be glad to have an opportunity of solving them, in the country of their illustrious author Robert Boyle.

At the Royal Society of London at the public meeting of May, 1665, direct transfusion was tried upon some dogs by Richard Lower's method, but without success owing to the defect of a badly contrived apparatus. The series of quill pipes which Richard Lower employed is far inferior to the almost perfect apparatus previously proposed by Folli, which, however, continued to be ignored even in Italy itself.

The operation also no doubt failed because then as now the influence of a numerous public who were either merely curious, indifferent, or sceptical paralysed the performer of a delicate operation, which might have been easily carried to a successful issue in private.

The French men of science of that time conceded to the English savans the honour of having been the first to experiment on animals, but claimed the priority of the theory of operating on man for Robert des Gabets, 1651—1658. Denys had declared that he followed the process of operation indicated by Richard Lower, and tried at the Royal Society of London.

The English in return, in the 'Transactions of the Royal Society' (1790), accorded to the French the honour of having brought about this great advance, viz. the application of transfusion to man, at the same time declaring that the English savans would have accomplished the operation long since had they not been restrained by religious scruples and a law more rigorous in such cases than the laws of other nations.

Thus we see that already in 1660 there was a powerful class of persons who, knowing little themselves, wished to prevent others from acquiring knowledge, and thought it more humane to suffer a man to die through ignorance than to cut off the tip of a rabbit's ear for purposes of scientific research.

Antivivisectionists are by no means a modern development. "*Nil novi sub sole?*"

In 1668 Edmund King and Thomas Coxe tried transfusion on sheep, calves, and dogs, and shortly afterwards Richard Lower and Edmund King practised it with success on a lunatic named Arthur Cogan.

Nevertheless, the new operation succumbed in England no doubt to the same kind of opposition as in France, and fell thenceforward into oblivion. Nor was it till 120 years had passed that the word of transfusion was pronounced again.

For the philosophical mind it is very curious and interesting to see how closely the present condition of transfusion resembles the condition of its history 200 years ago. We find the same theories then as now, the same kinds of apparatus, the same experiments on animals, and the same stages in its gradual application to man, beginning with the transfusion of animal blood with the same error of not perceiving that there is a natural antipathy between the species. Then, again, we notice the same rare cases of success, the same want of foresight, the same disasters at regular public meetings, the same indifference of professional bodies, the same opposition, and almost the same abuse from adversaries (*vide* Gesellius and Panum), the same disputes as to priority of invention

(*vide* Montcoq and Mathieu); the same reluctance to accept progress, and all the while then as now death's eager haste to reap unchecked its plenteous harvest of victims to hæmorrhage and diseases of the blood.

England, which had been the last to fall asleep in 1668, was the first to reawaken in 1792, after a silence of 120 years.

In 1792 Russell, at Eye in Suffolk, was present at the death of more than twenty persons suffering from rabies. He decided to bleed almost to death a young man who was seized by this incurable and horrible form of hydrophobia; then he restored his strength by transfusion and cured the rabies.

The same year Harewood, professor at Cambridge, restored by transfusion a dog which had been bled to death in presence of his pupils.

Darwin in 1796 advised transfusion in cases of fever, of stricture of the œsophagus or stomach, and in cases of inanition.

In the rest of the world only some few men of science admitted the utility of transfusion, but practised it little if at all. Such are Manfredi and Michel Rosa of Modena, Mathieu Purman, Ettenmuller, Balthazar Kauffmann, Schmidt, Kuck, Hufeland, von Graefe, von Boer in Germany, de Lachapelle and Cantvel at Paris.

Transfusion in Modern Times.—A scientific sleep of twenty-five years then ensues, till in London Blundell, in 1818, decidedly rearoused attention by his magnificent labours. He had seen a young mother succumb in two hours to puerperal hæmorrhage, in spite of all

means employed to save her. This terrible sight, which is also still frequent, had roused in him the determination to investigate the best means of conveying blood to one who is dying from the loss of it.

Blundell undertook a long series of experiments on animals, and obtained proof that the passage of blood through an apparatus does not render it unfit to perform its vital functions, but that if the blood has remained for longer than three seconds in contact with the apparatus or with the air, it always has fatal results, more or less rapid, upon the animal which receives it.

He subsequently attempted transfusion on man, and after two failures succeeded in saving life in many cases of hæmorrhage. His process was simply to receive the blood which flowed from the vein of the blood-giver's arm in a conical glass. This he next pumped into a syringe, and then injected it with great precaution, in order to prevent the penetration of air and formation of clot.

This does not constitute direct transfusion, but is mere injection of unimpaired blood.

Since the labours of Blundell transfusion has never been lost sight of in England and other countries, but, from want of a proper method and apparatus sufficiently perfected, the results but rarely answered the expectations of the operators, and the cause of transfusion made way but slowly.

Among the English operators the following deserve mention:

From 1820 to 1830 Blundell, Doubleday, Urvins, Waller, Brigham, Jewell, Boyle, Baxton Brown, Howell, Daviss, Savy, Pointer, Douglas Fox.

From 1830 to 1840 Blundell, Ingleby, Bird, Healey, Fraser, Ashwell, Banner, Tweedy, Collins, Samuel Lane.

From 1840 to 1850 May, Brown, Greaves, Waller.

From 1850 to 1860 Blundell, Brigham, Higginson, Simpson, Wheatkrop, Lever, Bryant.

From 1860 to 1870 Higginson, Braxton Hicks, Greenhalgh, Thorne, Currey, Playfair.

From 1870 to 1876 Lister, Aveling, Barnes, Thomas, Ringland, Wagstaffe, and many others whose names I am sorry to forget.

It is worthy of remark that the English surgeons were animated by so practical a spirit as not to be deterred from the transfusion of natural and unimpaired blood, by the difficulties of performing the operation which so constantly met them in the tendency of the blood to coagulate rapidly. They sought to perfect their methods without betaking themselves to the injection of defibrinated blood, filtered, cooled or rewarmed, in which the German operators lost their labour.

Moreover, the English surgeons left alone the transfusion of animal's blood to man, and sought in a healthy man alone for the source of the blood to be given to one diseased.

In France the following names of those who performed the transfusion of unimpaired blood may be successively mentioned:

Clement, Savy, Olivier, Abèle, Danyaux, Roux, Monneret, Nélaton, Marmonnier, G. Devay, Desgranges, Dutems, B. Maisonneuve, Michaux, Courcy, Gentilhomme, Blondeau, Oré, Raynaud, Lande, Béhier, Nicaise, Brouardel, Roussel, &c., &c.

The Germans were for the most part deterred by the coagulation which unimpaired blood produces in bad apparatus, consequently the majority of German operators made experiments on and practised with trifling success the injection of defibrinated blood, a process which is now condemned. The only Germans who have performed the real transfusion are Klott, Schroegler, Bickersteth, Schneemann, Meyer, Seyferth, and O. Heyfelder.

The direct transfusion of the arterial blood of animals (*e.g.*, sheep, or sometimes rams and calves) has often been tried, with a very small number of slightly successful results, by Denys and Emmeretz, Lower and King, Kauffmann, Purman, Michel Rosa of Modena, and since 1850 by Gesellins, Hasse, O. Heyfelder, Roussel, Kuster, Huter, Sander, Manzini, Rudolfi, Medegari, Caselli, Ponza, Albini, Dattera, Livi, &c.

I do not intend here to discuss the merits of animal blood, if, indeed, there be any, relatively to that of man, from which it is quite distinct in that it comes from a foreign species. I only wish to demonstrate the possibility of transfusing the blood of man, and the security which may attend the operation, if only one submits to the necessary conditions.

On comparing and examining the works of various authors on transfusion this operation is found to have been the means of saving life, from the time of Blundell, 1820, to the end of 1875, in at least *eighty* cases of women dying from hæmorrhage in confinement, in *thirty* cases of wounds in war or of surgical wounds, in *fifty* cases of diseases of the blood or anæmic consumption, in *twenty* cases of typhus, cholera, hydrophobia,

syphilis, dangerous fevers, and in ten cases of blood-poisoning from asphyxia, scorbutus, &c.; say, a total of 200 authenticated cases of patients who have been rescued from death in a period of fifty years by the generosity of persons who have given them their blood, and by the skill and confidence of operators.

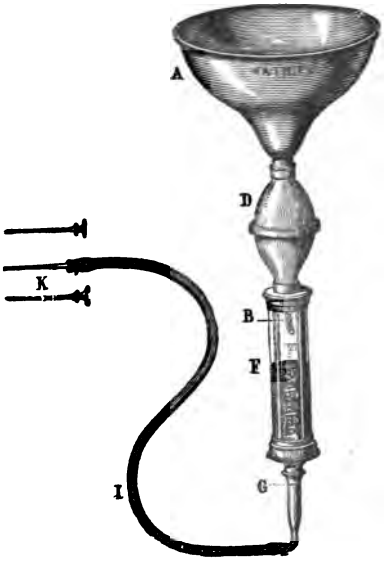
I have hopes that this number of persons saved may henceforward be attained each year, or even each month.

CRITICAL NOTES UPON VARIOUS METHODS

In the course of my studies I assisted at numerous unfruitful attempts to transfuse blood in the hospitals of France and Germany. Every transfusion of natural blood which I saw was rendered impracticable or interrupted by the coagulation of the blood in the apparatus, or else resulted in the immediate death of the patient in consequence of the penetration of blood thus impaired.

In the first place I noticed that the *direct transfusion of the arterial blood of animals to man,* which from the operator's point of view is easier to perform, is always followed by the gravest phenomena of the disturbance of the circulation, produced immediately by the immoderate amount of blood which the violent action of the animal's heart diffuses; that this is accompanied by equally serious secondary phenomena produced by the efforts of the circulatory system to get rid of this blood at once, which, coming from a different species, is unable to circulate and to retain its vitality in the human body.

MATHIEU'S APPARATUS



A is a large funnel of metal or glass taken from the apparatus of Moncoq, Collin, Pajot, Bellina, and many others. It serves to collect the blood, which flows exposed to the air, from the vein which has been opened. This blood is vitiated by the air, receiving from it particles of dust and germs, while it loses its gases, its temperature, and its density. The coagulation of the fibrine commences in the air, to be completed on the dry surface of the metal.

D is the balloon of Maisonneuve, Aveling, Richardson, Neudörfer, &c., made of sulphurised caoutchouc, a substance which is compound, has an uneven surface, is dirty and unworthy of coming into contact with blood.

B is the valve, resembling a reed-stop, of Maisonneuve and Leiter, formed of sulphurised caoutchouc, in which the course of the blood is arrested and clotted.

E is the large cylinder of the syringe, which is everybody's property This is made of glass, ostensibly in order to enable one to watch the conduct of the compressed air which half fills it; but since the blood coagulates on the entire surface of the glass it ceases to be transparent.

G I are tubes of metal and caoutchouc terminating in K, which is a metallic trocar to be inserted and bound in the vein of the patient.

many inventors of apparatus have succeeded, perhaps only in one case, and many others not even in one; and that there is not one of the methods previously adopted which is not defective in its practical application in one respect or the other.

In point of fact all these apparatus expose the blood to contact with the air, either before or during the process of transfusion. Experience proves, abundantly and conclusively, that the least contact with the air alters the blood and causes its coagulation, either in the apparatus, which renders the accomplishment of the transfusion an impossibility, or in the vein, which is a far more serious matter.

All these methods despoil the generous individual who gives his blood of a quantity of the precious liquid far in excess of that which can be given to the patient.

Finally, all preceding apparatus have the capital defect of being constructed of metal, glass, ivory, or impure sulphurated caoutchouc, substances contact with which soils and alters the blood, which coagulates on their surface, and, being detached by the friction, produces embolism in the patient's body.

Such, for example, are Moncoq's or Mathieu's (of Paris) apparatus, the latter of which appears to combine in itself all the defects of preceding apparatus, since it is composed of various parts copied from previous inventors.

Mathieu would seem to have devoted himself to devising the best means of inflicting on the blood the successive and repeated contact with all the substances capable of modifying and spoiling it.

and Dr O. Heyfelder, surgeon to the Zémonoff Hospital, and by Professor Küster, of the Augusta Hospital at Berlin.

The skill of these bold operators has enabled them to tie the brachial artery at the elbow without causing serious injury to the blood-giver, and with only the inconvenience of preventing him from working for ten days, until the collateral circulation has been re-established. They have also ameliorated the condition of the patients who received into their veins the arterial blood, but this amelioration has not been greater than that which is produced by the transfusion of blood drawn from a vein; this latter kind of transfusion has the advantage of not requiring extraordinary surgical skill, and has that of never being dangerous to the blood-giver.

I do not think that the example of MM. Heyfelder and Küster will be often followed, nor that many surgeons will be found willing to open and tie the brachial artery in a healthy man, nor that many healthy men will be content to allow their brachial arteries to be divided.

Besides, I do not by any means believe in the superiority of the arterial blood, which only remains arterial for one cycle of the circulation, and becomes venous in the body just as the venous blood which I employ becomes arterial while traversing the lungs. I consider that it is contrary to physiological principles to introduce arterial blood into a vein, and into those parts of the heart and lung which are constructed for contact with venous blood. Since it is into the venous circulation that the blood is transfused, it is from the venous system that it ought to be taken.

Arterial Transfusion with Animal Blood.—Arterial transfusion when practised on animals is interesting to the student of physiology. The following is the most perfect mode of operation that I have used in my preliminary researches.

The instrument which I employ is entirely composed of pure natural caoutchouc. It consists of a tube 16 centimètres (6 inches) long, fitted at each end with a wide canula of hardened caoutchouc. Near each canula is a branch-tube provided with a clamp, the one branch-tube used for the introduction, the other for the exit of the warm water with which the apparatus is to be filled in order to expel the air, and to render the instrument moist, soft, and warm, like the human blood-vessels. For this operation select as the *emittent* animal a vigorous lamb of four or five months old, bind it gently but firmly with leather straps on a short wide board pierced with holes for the passage of the straps, so that the animal may be easily carried on the board; lay bare its carotid or still better its femoral artery for two inches, isolate it from its nerves, tie the distal side, and pass two silk ligatures beneath the artery. Prepare the *recipient* animal in a similar manner, open its vein without dividing it, introduce into it the *efferent* canula filled to overflowing with water, introduce into the artery of the emittent animal the *afferent* canula and fix it then with a ligature; allow the blood to flow and at the same time a current of water to enter by the afferent branch tube and to pass out by the efferent one with the first jets of blood, to make quite sure that no air remains in the

apparatus; then close first the afferent and then the efferent branch tube, after all the water and the blood mixed with the water have been ejected. Now, while the blood is flowing from the one animal to the other, the surgeon, to prevent engorgement of the heart and lungs of the recipient, should take the tube by the middle, compress and relax it regularly each second so as to produce rhythmical jets, suspending the current of the blood from the emittent, and diminishing its violence; in this manner by the pulsation of the tube it may be ascertained that the blood is really being transfused.

By this method may be managed an excellent transfusion, but it is not possible to estimate exactly the quantity of blood which has been transfused, it can only be guessed at by the number of minutes which elapse.

Direct Venoso-venous Transfusion.—I prefer even in the case of animals to practise transfusion from one vein to the other, a method which allows of very exact calculation of the quantity of blood transfused, and may be repeated frequently without causing so much harm to the animal as is induced by ligaturing arteries and mixing arterial and venous blood.

The earlier operators perfectly understood, even in the year 1653, what some moderns still dispute, viz. that venous blood, whatever may be the apparent force with which it spurts at the first moment from a small puncture made in a large well-filled vein, as in ordinary

venesection; has not the necessary impetus to overcome the resistance and friction of the anæmic circulatory system. It is therefore absolutely necessary to propel the blood by an external force, which can compensate for that action of the heart which was sufficient in arterial transfusion.

Dom Robert des Gabets made an instrument of a tube furnished with a hollow leather ball of the size of a nut, fitted with valves, and ivory canulas. Professor Maisonneuve, of Paris, made some unsuccessful experiments with a ball of grey caoutchouc, with valves enclosed in ivory and glass tubes, and silver canulas. Professor Neudörder, of Vienna, and Küster, of Berlin, and Aveling, of London, employ hollow balls of sulphuretted india rubber, with or without internal valves, and canulas of copper or silver.

Whether these instruments date from 1766 or 1877 they have the same defects:—

(1) They are composed of materials which deteriorate the blood by contact.

(2) Even if they be filled with water before the operation, one can never be certain that no air bubbles are contained in them, and reasoning from that fact some philosophers have endeavoured to prove that if a certain quantity of air be introduced into the veins it will not necessarily be fatal.

(3) Their great defect is that their afferent extremities are formed by glass or metal canulas or trocars, which must be introduced into and tied in the vein which furnishes the blood. This practice necessitates a delicate and painful operation for the blood-giver, which is in general followed by phlebitis, and this phlebitis is

more or less serious according to the manipulations which the vein has had to undergo. If the surgeon is justified in taking some ounces of blood from one man in order to save the life of another, it is only on condition of taking all possible precautions against hurting him that he has this right.

Moreover, from an operator's point of view, this canula has the inevitable fault of having too small a diameter, and out of this narrow channel the blood can pass but slowly; too much time is requisite to fill the ball of the instrument, the blood stagnates, coagulates against the sides of the tube, and obstructs the passage; then the transfusion is arrested in the first few jets. This is what happened to M. Maisonneuve, and to M. Neudörfer, and this is what Dr and Mrs Hoggan complain of in No. 31, March, 1877, of the 'British Medical Journal.'

In conclusion, therefore, I consider that I am justified in maintaining—

That a good transfuser ought to have a direct and unbroken channel, but it ought not to be fitted to a canula at the afferent extremity, and it ought not to be constructed of a material which deteriorates the blood by contact.

ROUSSEL'S METHOD
AND APPARATUS

THE knowledge of these numerous defects which are found wholly or in part in all the old apparatus, and in many of those recently devised, is enough to ensure their rejection by all conscientious surgeons. These apparatus are, no doubt, excellent for the injection of water; not one of them is worthy of containing so delicate a substance as the blood of man.

Absolutely convinced of the soundness of my criticisms on former methods and apparatus, and assured that all had to be commenced afresh in this interesting question, I arrived in 1864 at the construction of a transfuser the principles of which are novel and based upon sound inductions, the main parts of which differ from all the forms known in surgery, while the process itself is absolutely free from those defects which are to be noted in former inventions.

In 1865 I made a successful transfusion in a case of puerperal hæmorrhage with this apparatus. In 1867 the design and the description of the transfuser were inserted in the 'Gazette des Hôpitaux' and the 'Archives

de Médecine' of Paris; but it passed without notice, although it was admitted to the Exhibition of 1867, presented to the Military Council of Health, and demonstrated at the International Congress by Dr Jaccoud, and at the Academy of Medicine by Professor Robin.

This silence is to be regretted, inasmuch as during the wars of the last few years the lives of thousands of wounded men might have been saved if the value of transfusion had been fully recognised by the profession generally.

From 1864 to 1876 the principles of the apparatus and the method of operation have undergone no modification whatever; the mechanism alone has been slightly modified and improved by the employment of hard caoutchouc in the place of silver. This is a considerable advance, for, I maintain, the principle arrived at by experience, that all contact with metal, as also with glass, ivory, &c., is injurious to the blood, and tends to coagulate it—an inevitable consequence if the blood is exposed for an instant to contact with the air.

Now there is a sulphurised caoutchouc employed in trade which is vulcanised, of a grey or black colour, a combination of a number of foreign substances, the gases and grit of which soil and coagulate blood.

My transfuser is entirely composed of pure caoutchouc, natural, non-sulphurised, and of hard caoutchouc, a neutral substance, which has no effect upon the blood, contact with which alters neither the tissues nor the animal liquids.

A. CONDITIONS OF THE TRANSFUSION

In my opinion the indispensable conditions of a good transfusion are—

1. That the blood be of the same animal species and from the same organic source; from man to man, from vein to vein.

2. That it should continue to be vital and unaltered in its most intimate composition, not having been subjected to contact with the air or any other modifying materials; and that it should have lost neither its motion, nor its temperature, nor its gases, nor its density.

3. That the quantity to be transfused and the rapidity of its flow should be subject to the discretion of the operator.

4. That the operation should be conducted without danger to either subject.

These conditions have never been either laid down or fulfilled. Hence it is that transfusion has not given the results which one has the right to expect; and that the attempted operations have often led us to serious accidents, which have brought upon transfusion unmerited discredit and neglect.

My method and my transfuser completely fulfil, I believe, all these indispensable conditions. They have given proof of this in a number of very successful operations.

This method of direct transfusion consists—

(*a*) In joining the vein which is to supply the blood to that which is to receive it by a conducting tube,

which is continuous, direct, and filled with water, consequently void of air, some time before the opening of the vein.

(*b*) On opening this vessel in a cushion of water, that is to say, protected from the air, by means of a lancet, in such a manner as to procure a sufficient jet of blood, by a simple puncture, such as is ordinarily made in bleeding. Thus all phlebitis is avoided, whereas it would of necessity be produced by the introduction and ligature of a canula in the vein.

Employment of Water.—The water which fills the apparatus up to the moment of transfusion, and in which it has been immersed, rinsed, and softened, must be at from 20° to 25° (Centigrade) in order to avoid all alteration in the temperature of the blood. I add a few grammes of bicarbonate of soda to the water, in order to cleanse the interior of the apparatus thoroughly.

Nevertheless, in urgent cases, cold water may be used if quite clean—a strait I have on several occasions been reduced to without any injurious result. The only purpose which this water serves is that of driving out the air contained in the transfuser; it does not penetrate to the vein of the patient in cases of simple transfusion.

Medicated Transfusion.—If particular indications should present themselves, it is quite easy to mingle with the blood, in the apparatus itself, a certain dose of medicated water in prescribed solution.

Transfusion with Electricity.—Or, again, one may enclose in the transfuser a current of direct electricity, and conduct it along with the blood into contact with

the heart itself, in order to reawaken that organ in the case of apparent death. All that is necessary is to bind the positive pole of a continuous current to the shaft of the lancet, and to prick the respiratory muscles with an acupuncture needle applied to the negative pole.

Temporary Ischæmia.—If the patient has been taken up on the battle-field, bloodless, in a state of syncope, and with the appearance of death, but not as yet overcome by absolute rigidity, it is of no use to attempt to rouse him from this syncope which has suspended the loss of the last drops of blood. Temporary ischæmia should be produced with Esmarch's apparatus, not only upon the wounded limb, but also upon the arms and legs, which are free from injury, from the extremity to the root, in order to drive back towards the central organs the blood which is actually useless in the limbs. This tends to restore the hydrostatic equilibrium which is disturbed by hæmorrhage; next one unbinds the limbs one after the other, during the process of transfusion, in order to permit the new blood to spread over the whole organisation.

Depletive Process of Bleeding.—On the other hand, if the case be one of asphyxia, of drowning, or of poisoning, it is necessary to effect a large opening in the vein, or even in the artery of the opposite arm, in order to make room for the new blood, to eliminate as much as possible of the altered blood, and to afford to the heart, in the case of apparent death, a greater facility of action, the natural consequence of the opening of an artery.

B. PREPARATION OF THE VEIN OF THE PATIENT

In a case of anæmia resulting from hæmorrhage the superficial circulation is, as it were, suspended for the benefit of the central organs. The veins of the arm or leg are empty, flattened, colourless, and invisible through the skin. In a case of chronic anæmia these veins are contracted and of small calibre. It is manifestly an error to attempt to plunge into such vessels a trocar or canular needle, and to hope to penetrate with accuracy without passing right through them, and without going astray into their coats or into the surrounding cellular tissue.

To employ a lancet, as in bleeding, and to introduce a canula into the puncture, is an equally hazardous proceeding. The most skilful operators have often failed in this little operation, and have forced into the membrane an injection which ought to have penetrated into the vessel.

The patient is in a critical situation from the very fact that he requires transfusion, and the incision of the skin of the arm to a length of two or three centimètres, even should the edges chance not to reunite by the first intention, kicks the beam of the balance; if on the other side, imminent death weighs down the scale.

Does the surgeon who is about to save an infant's life by tracheotomy hesitate in face of the gravity of the wound which has to be made in the skin of the neck?

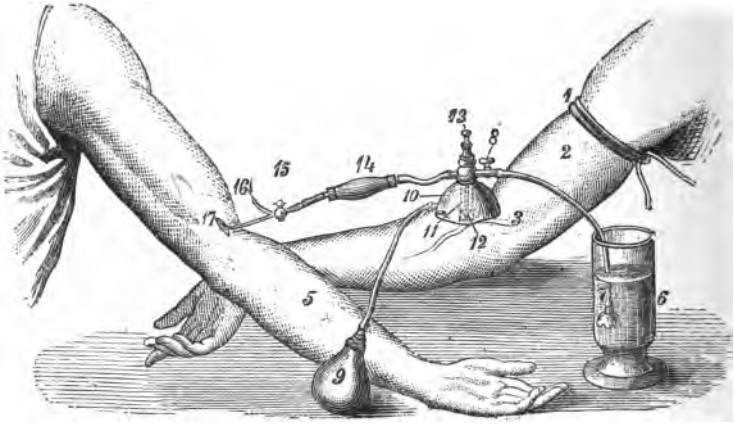
In order to perform the little operation which I propose without fear, either of thrombosis, ecchymosis, phlebitis, reflux hæmorrhage, or interruption of the

ascending venous current, an operation which is necessary to ensure the complete penetration of the transfused blood, a fold must be made in the skin, and cut with a bistoury in the direction of the vein, in such a manner as to enable one to see the latter clearly, but without injuring or exposing it. Then the external coat must be punctured with a fine hook (érigne), or tenaculum, or forceps, and an incision made in the vessel in an oblique direction with the point of small curved scissors. A small flap in a V form is then cut, which, being supported by the crotchet, serves as a guide, and allows of the sure and harmless introduction of a pliant canula, which is driven into the vein to a distance of two centimètres. The finger of an assistant, laid crosswise upon the centre of the canula, fixes it in position and closes the little door formed by the flap of vein, which falls back into its place after the transfusion. Should the obscurity of the vein have necessitated a somewhat long incision, a suture-pin passed through the skin will ensure the exclusion of air from the wound, and its cicatrisation by the first intention. I usually select one of the veins of the arm as being more convenient, but in the case of a delicate subject, one may operate on a saphena, which, being further removed from the heart and the lungs, diminishes the sensibility of those organs to the impression of the jet of transfused blood.

Should transfusion be necessitated by hæmorrhage resulting from an amputation, it might be performed directly to one of the veins of the stump.

It is scarcely necessary to add that before thinking of transfusion the operator has already staunched, so far as is possible, the source of the hæmorrhage.

C. ROUSSEL'S TRANSFUSER



1. Bandage for bleeding.
2. Arm which supplies the blood.
3. Vein swollen for bleeding.
5. Arm which receives the blood.
6. Vessel containing water.
7. Bell of the aspirator.
8. Tap which shuts the water off.
9. Round balloon to regulate the cupping-cup.
10. External envelope of the cupping-cup.
11. Internal cylinder in the cupping-cup.
12. Lancet inside the cylinder.
13. Screw which regulates the lancet.
14. Balloon pump of the transfuser.
15. Tap at the bifurcation.
16. Canula by which the water escapes.
17. Canula inserted into the patient's arm.

D. THE SUCCESSIVE STAGES OF DIRECT TRANSFUSION

1. Place the cupping-cup (10) over the turgid vein of the blood-giver; adjust the lancet (13); pump in the tepid water.

2. Introduce the canula (17) filled with water into the anæmic vein.

3. Depress the lancet rapidly (13, 12) into the turgid vein (3); shut off the water aspirator (8); drive out through the escape canula (16) blood mingled with water.

4. Open the communication by stop-cock (15) into anæmic vein, and transfuse pure blood in uninterrupted doses of 10 grammes (one third of ounce).

5. After the transfusion of the prescribed dose place a simple bandage round the arm of each subject.

6. Wash the transfuser at once in warm water before the coagulation of the blood.

E. DESCRIPTION OF THE TRANSFUSER

My circular cupping-cup (10), which is an absolutely original idea, is, nevertheless, the cause of the silence which has reigned for ten years respecting my transfuser. No sooner had (in 1867) the 'Gazette des Hôpitaux' published a description of it than a manufacturer who claims to be the inventor of all surgical instruments, past, present, and to come, without having understood or even seen my apparatus, published the following declaration in the same gazette :—'I Mathieu

invented long ago an apparatus for transfusing blood commencing by a cupping-glass, and it was a worthless apparatus. Dr Roussel is the inventor of a cupping-cup; *ergo* his is a copy of my cupping-glass; *ergo* his is worthless, and so forth." This statement was credited without investigation; his influence was considerable then, but since that time—well, I will only say that many others besides myself have had to combat his unwarranted assertions; for my part I have lost ten years. The cupping-glasses of Mathieu, Moncoq, and others, are mere enlargements, in the form of a funnel, of the tube by which the blood enters—enlargements which are adjusted to the open vein, which cease to act as cupping-glasses, since they themselves fill with blood. This liquid coagulates rapidly in a cupping-glass. Mathieu was quite right in declaring that his was a worthless apparatus.

My cupping-cup is an envelope external to and independent of the transfuser; neither the blood, nor the water, nor the air, can penetrate to it; it only serves as a support for the cylinders, and fixes it on the skin.

The transfuser consists of a balloon-pump (14),* made of elastic caoutchouc, which serves as an exhauster to draw the blood from the vein of one of the subjects and to introduce it into the vein of the other by an uninterrupted movement so as to avoid the slightest check in the course of the blood. This oval balloon, of delicate construction, is perfectly polished in its interior, and free from any unevenness which could favour coagulation. It contains ten grammes of blood,

* The numbers in brackets refer to the figure on page 44.

and thus admits of a highly accurate measurement of the amount transferred, according to the number of movements of the compressible balloon.

This balloon is firmly clasped in the hand of the operator, who is thus able to appreciate the resistance offered by the organism transfused, and to hasten or retard the course of the blood according to the indications.

This balloon regulator pumps the blood by the medium of a rigid cylinder (11) applied to the skin. In order to fix this cylinder in such a manner as to prevent all ingress of air, I have surrounded it with a kind of rigid cup, which takes the character of a cupping-glass (10), worked by a special air-ball of its own (9).

The cylinder is at first open from above, which enables one to see with great exactitude, and select the point for bleeding which it ought to envelop.

When by means of the cupping-cup the apparatus is in its place on the arm of the blood-giver, the cylinder is closed by the insertion of the lancet-holder (13). This lancet is mounted on a millimetrical screw guide, by which means one can regulate with mathematical precision the penetration of the blade, according to the thickness of the skin to be traversed, the diameter and the depth of the vein, which one must not hesitate to open freely. This vein must be a median of large size and well fixed in the cellular tissue, a little above the bend of the elbow, at the spot where it commences to gain depth, and as far removed from the artery as possible. The direction of the blade is modified at the discretion of the operator by means of two metallic points fixed at the head of the lancet (13).

TIONS

PERFORMED

CAL CASES

case of Puerperal
covery.—This was
December, 1865, and
pamphlet, with a

advantage of pub-
progress of the
have been rapid,
the late wars

Patient A. P.,
miscarriage;
waked through
I perceived
No pulse, no
the heart
Syncope
Mrs B.
Good for a
slight hope

of success. The patient being in a state of syncope did not feel the operation; the vein had become invisible owing to loss of blood, and was difficult of discovery.

The transfuser was applied to the sister's arm; and water pumped in, in order to fill the apparatus and expel the air. After the puncture by the internal lancet the apparatus quickly became filled with blood, and the canula was inserted into the patient's vein.

When 110 grammes (4 ounces) of blood had entered the circulation, the heart commenced beating irregularly and respiration recommenced feebly.

After 200 grammes (7 ounces) had been transfused the face and chest were sharply rubbed with a linen cloth steeped in cold water. A violent hiccough ensued with strong respiration, the heart still beating irregularly.

After receiving 320 grammes (11 ounces) the patient opened her eyes. The face reddened and the heart palpitated strongly; a frothy saliva issued from the mouth and the respiration became deep and rapid.

At this moment Mrs B. uttered a loud cry of joy, and succumbing to her emotion fell fainting from her chair, dragging after her the apparatus, which obliged me to stop the transfusion. I bandaged her arm quickly and left her to the care of her friends.

On returning to the patient I found her eyes wide open, and an expression on her countenance as of one who had returned from the other world!

She had an attack of coughing, and expectorated a little clotted frothy mucus which relieved the chest and rendered the respiration free and regular. I then bandaged her arm, and gave her a warm cordial (tea

and rum). The pulse was 120, very hurried. Respiration 30 to 32.

At the end of half an hour she was seized with a severe rigor and weakness.

I feared the hæmorrhage was recommencing, and upon examination I found that the uterus had expelled the placenta, and had contracted; that she had no power over the sphincters, but that blood was no longer flowing.

I had her placed upon a clean and well-warmed bed, and gave her another cup of tea. Towards midnight she was much better, and quite conscious, asking for sleep. Pulse 108. She slept for two hours, with a gentle perspiration, free from pain and all dangerous phenomena, in short, quite saved.

Next day she felt very weak, but not more so than a young mother whose accouchement had been laborious might be expected to be.

On the eighteenth day she was able to get up, and forgot that she had been as one dead for upwards of a quarter of an hour. She is now the mother of a large family.

Her sister, Mrs B., felt none the worse for the sacrifice she had made of her blood; indeed she was so little affected by it that, on the next day, seeing her sister still very weak, she asked me to perform a second transfusion, which, however, I found unnecessary. Her arm was healed in two days.

Remarks.—Direct transfusion of vital blood was the sole means of saving the life of this young mother, who would certainly have died but for its succour.

I have performed three other successful transfusions

in similarly desperate cases, and I hope that henceforth no accoucheur will permit the approach of death to a woman from puerperal hæmorrhage without attempting to save her by transfusion.

Friends and relatives should demand it, and the surgeon be allowed to select from among those present the person whom he considers best adapted for a successful transfusion.

OPERATION 2. *Transfusion in a case of Hæmorrhage and surgical chronic Anæmia; Recovery.*—Removal of a large cancer from the leg. Diphtheritis, epidermic grafting.

St Petersburg, February 16th, 1874. Amphitheatre of the Medico-Surgical Academy of Professor Korzeniewsky, in presence of the medical inspectors, professors, and 200 students.

Patient, Mayers Sprinzoff, aged 44; extensive epithelioma of the thigh, 11 inches long by 9 inches wide. Had been ill four years. Anæmic to the highest degree, fever at night, and so weak that amputation had been regarded as impossible. The professor only consented to it on condition that I performed a transfusion in order to avoid death. During the amputation of the part affected considerable hæmorrhage was caused, which further aggravated the chronic anæmia of the patient.

Pulse imperceptible at the radial artery, 75, irregular and thready at the carotid.

Professor O. Heyfelder prepared the median vein of the patient, while I made ready the transfuser. Direct transfusion of 280 grammes (10 ounces) of blood, taken from a hospital assistant—no disturbing phenomena.

Date.	State of Patient.	Pulse.	Temperature. Centigrade.	Respiration per Minute.
February.				
16.—Morn.	Great weakness	95, weak	36°	18
„ before transfusion	Extreme weakness	84 slight	32°	16
„ during transfusion	No disturbance	108	37·5°	20
„ 1 hour after	Slight rigor for 15 minutes	72	36°	16
„ 3 hours after	Calm, perspiration	108, full	36·5°	20
„ 4 hours after	Normal stool, sleep	90	37·5°	18
17.—Morning	Has passed a good night	90	37·4°	16
„ Evening	Good appetite, no pain	95, full	37·8°	18
18.	Satisfactory. Wound of amputation doing well, that of transfusion healed	85	36·5°	18
19.	Satisfactory. Good appetite	90	36·5°	20

Urine on the 16th before the transfusion 2500 cubic centimètres, density 1010, little albumen.

Urine on the 17th after the transfusion 2200 cubic centimètres, density 1008, coloured yellow, no blood.

February 25th.—Patient less well, has eaten too much ; diarrhœa, fever, three diphtheritic spots on the wound of the leg. There has been diphtheria in the wards of the hospital for some days.

28th.—The malady had diminished, the wound better, slight fever in the evening, the appetite had returned, painful swelling in the glands of the groin.

March 1st.—Diphtheria diminished, no fever.

4th.—Swelling of groin reduced, wound looks well.

10th.—Wound of leg was doing well, but it was so extensive that it failed to cicatrise.

30th.—I proposed epidermic grafting (after the method of Reverdin of Geneva). Five fragments of epidermis were grafted on the wound.

April 4th.—Four fragments of grafted epidermis had taken root.

18th.—Wound cicatrised well round the extremities, as also round the edges of the fragments of grafted epidermis. General condition good.

May 1st.—Complete cure.

Remarks.—It was positively certain that without transfusion this man, so greatly affected, would have succumbed to the surgical operation, or to the contagion of diphtheria, which retarded his convalescence. A large number of those who had undergone operation, or had been wounded in battle, still succumbed. They should henceforth be sustained by transfusion.

OPERATION 3. *Transfusion in a case of chronic surgical Anæmia; Recovery.*—Charing Cross Hospital, under the care of Mr Barwell, reported by him to me and in the 'Lancet,' April 21st, 1877.

Transfusion has been employed with great advantage in cases of hæmorrhage, whether post-partum or from wound, but not, as far as I am aware, in that condition of system which may aptly be termed chronic traumatic

anæmia—a condition of anæmia and bloodlessness produced by long-continued suppuration and by the waste of reparative processes larger than the patient's strength can support. In such states the sufferer generally eats but little; he may, perhaps, take a fair amount of stimulants, and may have quinine, iron, or other tonics administered. Yet, whether he eats little or much, or however he be treated, his strength diminishes day by day, his blood-supply gets smaller and smaller, until at last he has not enough to carry on the work of his body and its organs. In these conditions I have been constantly struck by the powerlessness to which the surgeon is reduced. The stomach is his only hold upon the patient's life, but the capacity for digestion and assimilation diminishes constantly. Assimilation simply means the conversion of food into blood; and I have long thought that if we could spare the stomach this work, and give blood ready-made, we might save many a patient and many a limb that would otherwise be lost. On becoming acquainted at the Medical and Chirurgical Society, with Dr Roussel's instrument, I felt the only scruples I had, namely, the fear of embolism and other such dangers, disappear. Therefore, after having seen this instrument, and carefully studied its action and advantages, I determined to put this idea to proof in the first case which seemed to me suitable. This occurred in the person of—

John D., aged 44, admitted into Charing Cross Hospital under my care with compound fracture of tibia and fibula, 2nd December, 1876.

The man is of sedentary occupation, and rather intemperate. He is pale, anæmic looking, and for years

past has had winter cough. The fracture occurred in both bones about the junction of middle and lower third. The external wound, fully an inch long, jagged and bruised, communicates directly with the fracture. The case was treated antiseptically, but either on account of severe bruising of parts, or of depressed constitution, the wound did badly, while the patient himself had a smart attack of traumatic delirium, requiring energetic and careful treatment. On the 16th of December, as the contused soft parts had sloughed, and suppuration had fairly set in, antiseptics were discontinued.

1st February, 1877.—The ends of the tibia, being necrosed, were removed with the saw, and the limb put up in an interrupted metal splint and plaster of Paris. In a few days the truncated bone-ends were granulating healthily; the wound contracted somewhat, though very slowly. Though, therefore, suppuration seemed not extending, yet repair was very slow, if it could be said to be going on at all. The granulations were pale and flabby, just capable of supporting their own life, but hardly of repairing large injury. He complained of constant dull aching at the part, which occasionally was severe enough to keep him awake. The man was getting weaker, paler, and more anæmic, the pulse smaller and weaker, the appetite less and more capricious. I therefore wrote to Dr Roussel, who kindly acceded to my request, and came with one of his transfusion instruments.

28th February.—Previous to transfusion at 10 a.m. the patient was pale, lips and palpebral conjunctiva very slightly coloured, eyes rather dull and sunken;

he is quiet, almost apathetic. Pulse about 115, small and weak; temperature 99° (Fahr.); appetite small, requiring much tempting.

3 p.m.—The vein was laid bare by Dr Roussel; it was very small and contracted, nevertheless Dr Roussel succeeded in opening it; when, as his attention was required to the blood-giver, he requested me to introduce the canula. In this there was at first some little difficulty, partly owing to the contracted state of the vein, partly to the opening being made by one person, the introduction by another; a little blood became therefore effused under the skin, which produced a thrombus. This was soon rectified, and the patient received from the arm of Mr Watson, student of the medical school, 8½ ounces of blood, being 25 strokes of the "ballon." During the operation, the patient's eyes became bright and fuller, his face flushed, skin warm and moist, and after a little while perspiring freely, pulse fuller and stronger, 95. He complained of a sense of fulness and oppression at the chest, but after taking two or three deep inspirations, as he was directed, this feeling disappeared.

After the operation he had a sense of fulness down the spine, and some aching at the loins, otherwise was very comfortable. The granulations at the seat of fracture, which had previously been pale and flabby, were now well coloured, and of good consistence. The dressings were very slightly blood-stained, but whether this was the effect of moving him, or from the rupture of some small vessel, by the rapid influx of an unaccustomed quantity of blood, cannot be decided. About half an hour after he was put to bed, he had a

slight rigor, soon followed by a second, afterwards by copious perspiration; he felt very thirsty, had no pain or discomfort, the feeling of fulness at the back had become one of strength, as he expressed it. In the evening his temperature was 102°, pulse 94. The urine was abundant, odorous, loaded, but perfectly free from either blood or albumen. Pulse 94; temperature 95° F.

1st March.—During the night he slept fairly well, waking up about every two hours, and quickly falling asleep again. He ate a better breakfast than he had done for some time; temperature 100°; pulse 98, still perspiring, the wound in the leg looked much healthier, urine normal. During the day he had some headache, tongue rather coated, bowels had not acted; temperature at 8 p.m. 95°; pulse at 90. Ordered castor oil ℥ss.

2nd March.—The aperient has not acted. He slept indifferently during the night; felt rather sick; had headache and a rather coated tongue; slight icteroid tinge of conjunctivæ. Temperature 102°; pulse 100.

Calomel gr. ij, to be taken immediately.

Haust. Sennæ Comp. six hours after.

3rd.—Since the action of the medicine the patient is much better. There is no headache, the tongue has cleared, and the temperature is little above normal. The pulse retains the character which it has had since the transfusion, large and full, but soft.

5th.—He was kept restless during the night by pain about the wound in the arm, which is surrounded by a hard red blotch; his temperature has risen to 100·1°; pulse 90, full, rather harder. Poultice to the arm.

6th.—Passed a fairly good night, having received under the skin half a grain of morphia. The arm is easier this morning, and pus having formed a little above the operation wound, an incision was made; it is a cellulitis arising from thrombus, and resulting in abscess, not a phlebitis. Temperature, 10 a.m., 102·4°; at 10 p.m., 100·2°; pulse 95.

7th.—Slept without an opiate, and is comfortable, appetite fair, no headache or other discomfort, the wounds in the arm discharge freely; temperature 99·6°.

14th.—Steady improvement since the last report, he eats, sleeps, and feels well. Temperature averages 99°, pulse remains full and soft. The suppuration about the arm has given a little trouble, and, perhaps, has kept his temperature a little higher than it would otherwise have been; but it is, I wish to point out, a mere local cellulitis, not phlebitis. The wound in the leg is filling up healthily, and there seems some amount of union between the bones. There has been no pain at the seat of fracture since the transfusion.

Remarks.—April.—It appears scarcely necessary to report the case further, for as the patient is doing perfectly well, it justifies the following remarks. Previous to transfusion, the man's vital forces, under the influences of shock of the accident, sloughing of soft parts, necrosis of bone, operation and very free discharge, were rapidly giving way—threatened, indeed, if the same rate of diminution continued, to become before long extinct. From the moment when he received fresh blood, all these conditions were changed. His strength, the action of his circulatory system and of his assimi-

lative powers, have been restored. Any embarrassment, traceable in the headache, nausea, and coated tongue, points rather to excess of blood than to debility. It may be, that if the usual free evacuation had followed the transfusion those symptoms would not have arisen; but they may be interpreted otherwise. A man who has lost blood by wound, or a woman who has had post-partum hæmorrhage, suffers from deficiency of blood very suddenly. The organs have always been used to a much larger amount. A patient with an injury which by discharges, and other debilitants, gradually exhausts the blood-supply, suffers under a chronic form of anæmia. The organs have become more or less slowly accustomed to deal with a small quantity of blood; if to that small quantity several ounces be suddenly added, we must expect that certain organs, liver and spleen, will be for a time embarrassed. Probably it is better to compound with this disturbance, than only to transfuse a small amount of blood, with the possibility of conferring an inadequate amount of benefit, and of being obliged to repeat the operation. The symptoms of embarrassment in the above case passed away on the fourth day after the action of a rather smart purge.

Dr Roussel says that the examination of the first urine furnishes a criterion of transfusion, and that it always contains some *débris* of the globules and albumen and red colouring matter of the blood, if the transfused blood exist in great excess, or becomes altered in its passage, or is the blood from some other animal species. In this case a careful examination of the urine neither showed blood-globules nor albumen.

He says also that transfusion ordinarily produces an unusual activity of all the organs preventing congestion, and is followed by copious alvine discharges, but in this case there were no evacuations, and therefore artificial means (calomel), &c., were resorted to.

Thus, therefore, it seems that the great benefit of transfusion in cases of debility after severe injury is by this case fully vindicated, and that in future *it will become one of the recognised resources of surgery;* that, instead of exposing weakened, almost exhausted, patients to the dangers of secondary amputation, we may by this means save not only the life, but the limb; that we may, in fact, when the patient has exhausted all his own sources of power, bestow upon him a fresh supply, and start him on his work with new capital.

I cannot conclude without recording my high appreciation of Dr Roussel's apparatus. *The ingenuity of its plan, the care expended in the choice of material, and the mode of workmanship are all admirable.* I must thank Dr Roussel for his affability in assisting at this case and in teaching me to thoroughly well understand and manipulate his admirable invention.

B. TRANSFUSIONS IN MEDICAL CASES

OPERATION 4. *Transfusion in a case of chronic Chloro-anæmia; Recovery.*

Cronstadt, March 24th, 1874. Private practice. *Patient* Miss Iwanoff, aged 39. From the age of 18 to 30 very frequent and serious losses of blood, and hysterical attacks. She kept her room for twelve years, and her bed for more than seven.

Extreme chloro-anæmia, frequent syncope, and hysterical attacks. Violent nervous pains, and constant headache, very irregular courses, alimentation difficult, pulse scarcely perceptible, death certain in a short space of time.

The patient herself requested a transfusion of blood as a last remedy. Said she would sooner die at once than linger on in her present condition. Her family begged me to operate, her brother offered his blood.

The family physician, Dr Taïroff, prepared the patient's vein, while I adjusted the transfuser to her brother's arm.

The patient prayed aloud during the whole course of the operation. I operated very deliberately, fearful of provoking a nervous attack. on so impressionable a subject.

I gave her 250 grammes (nine ounces) of blood. The face gained colour rapidly, the eyes brightened and were wide open, pupils dilated, respirations vibratory and rapid. Towards the middle of the operation she was somewhat agitated. Said she was burning all up

the arm, then in the heart, finally all over the body; that she could endure the heat, that she felt herself swelling; that she was going to have a nervous attack. I told her firmly to keep quiet, to be calm, and to resume her prayers. She repeated the Lord's Prayer aloud. The transfusion was completed without any trouble. I bandaged the arm, and had her placed in a warm bed, and made her drink some hot tea.

When half an hour had elapsed she had a slight rigor, followed by moderate perspiration, then she felt inclined to sleep. Slept for two hours, calm, slight perspiration. On awaking she felt no pain, and declared that she was stronger. She ate twice without vomiting. Passed a fairly good night, with some slight rigors.

March 25th.—No pains. Slight dyspnœa, and cyanosis of the lips, associated with slight feeling of oppression in the stomach. In the evening passed an abundant and healthy stool. Urine normal.

Condition of the Patient.	Pulse.	Respirations per minute.	Temperature. Centigrade.
Before transfusion. Very pale. Pulse irregular . . .	112	24	35°
During the transfusion. Face has gained colour	90	37	38°
30 *minutes after.* Slight rigor .	110	30	37°
1 *hour after.* Sleep . . .	100	28	39°
Next day. Better. Appetite good	102	30	37°
Two days after. Still better .	100	30	37°

The arms of both persons had healed in two days.

On returning to St. Petersburg I received letters from the Cronstadt physicians, informing me on April

2nd that "the effect of the transfusion had been astonishing. On the third day the patient already felt very well; the neuralgic symptoms had entirely disappeared; the appetite was better than it had been for several years past." "All was going on admirably till the 31st March, when symptoms of acute gastritis appeared, and the patient suffered from vomitings and diarrhœa, which still continued. It is possible that she might have taken too much nourishment, or it might have been an attack of cholera, of which we had several cases at Cronstadt. She had declined considerably; we kept up her strength with champagne, &c. &c."

In a second letter, dated April 30th, they wrote, "We are rejoiced to have the pleasure of informing you of the cure of your patient. The intervening malady gave way in a few days. The appetite and strength had returned, and were such as they had never previously been. She gets up every day, and can leave her room and walk, which she had not done for ten years. In a few days she is going down to Riga for the summer, as the climate there is better. Your transfusion is a wonderful operation."

Remarks.—In many families there are poor boys and girls suffering in a similar way. Transfusion should be tried when it is found that ordinary medicines are of no avail, before an incurable consumption is developed.

OPERATION 5. *Transfusion in a case of Anæmia from Hæmophilia; Recovery.*—Paris, Fontenay-aux-Roses. May, 1876. Private practice.—During my stay at St Petersburg in 1874, Mr de K., of Stockholm, consulted me by letter with respect to his son, who was suffering from hæmorrhage, constantly returning, either from the nose, the gums, or from the least excoriation of the skin, lasting for whole days in spite of all the means employed to check it, and to such an extent as to reduce the child to a condition bordering on death. The blood when collected in a vessel did not coagulate, appearing greasy and of a yellowish colour.

It was easy for me to recognise a case of constitutional hæmorrhage together with leucæmia, and I was able to reply to the father that a former success in a similar case justified me in giving him hopes of effecting a cure by transfusion.

Hearing that I was at Paris the whole family removed thither. The little boy, aged 12, is tall and thin; face puffed, eyelids heavy, hair light, fairer than raw silk; skin thick, flabby and white; the ankles swelled, respiration feeble and heavy, but without any troublesome sounds in the lungs; the heart and the carotids produce the musical breathing sound of anæmia in a marked degree.

During a month's residence at Fontenay my preliminary treatment, the change of climate and diet, and the manner of living, &c., produced a decided amelioration, and the boy had no return of hæmorrhage.

On May 3rd, however, while playing in the garden he received a blow in the face, and the blood flowed

from the left nostril and vicinity of the canine tooth. It was impossible altogether to arrest the hæmorrhage, which ceased of itself at the end of forty-eight hours, during a prolonged syncope of the little patient.

The blood was liquid and of a reddish-yellow colour, and at the end of twenty-four hours it had scarcely begun to coagulate; on linen it produced a spot which spread and separated into two parts, viz. a centre of a red colour, and a large ring of a pale rosy yellow. Examined under a microscope, a drop of the fresh blood showed a great many white, colourless corpuscles, more in number than the red globules.

May 5th, morning.—Direct transfusion of 280 grammes (ten ounces) of the blood of a strong young man, whom I selected with care. The child was apparently in a dying state, almost without pulse. I operated very slowly for ten or twelve minutes. No disturbing phenomena. Pulse 120. The heart and lungs regained their activity. Consciousness was completely restored.

Half an hour later two somewhat marked rigors succeeded, and lasted for twenty or thirty minutes. Pulse 90. I administered a hot cordial. Perspiration.

Sleep slightly disturbed. The child slept for four consecutive hours, and on waking said he had a headache and was very hungry. Pulse 110.

I removed the staunching apparatus from his mouth, together with the pad applied to the nostril and the lips, with which I had nearly succeeded in arresting the hæmorrhage, and then gave him a substantial amount of soup, which he swallowed with avidity.

The hæmorrhage did not return, and I was unable

to discover its sources. The canine tooth appeared to me to be shaken, but I took care not to test the truth of this supposition.

First urine abundant and deep coloured, with a little albumen. The boy's father informed me that at each attack of hæmorrhage the urine became albuminous for several days.

I remained for two days by my patient, who was on four occasions taken with rigors followed by slight sweating. Pulse 90, full.

I observed the astonishing activity of the stomach which ensued on transfusion, and which was the best indication of a complete and speedy cure. The child always complained of hunger. I did not, however, dare to give him solid nourishment, such as bread and meat, which he asked for, fearful of disturbing the canine tooth, the probable source of the hæmorrhage, while successive draughts of soup and minced meat could not shake it. At last, on the third day, I permitted him to eat an ordinary meal. The hæmorrhage did not return.

The anæmic sounds had ceased in the heart and lungs. Pulse 90.

From this day the general condition of the child changed completely; the swelled ankles gained their normal condition, the eyelids and the skin fined down and regained their colour, the limbs became vigorous, and the hands and feet were no longer moist from the perspiration which formerly covered them.

The respiration, circulation, digestion, and sleep became excellent, and in three months the child gained flesh, and his weight increased by nine kilogrammes.

The De K— family returned to Sweden. There was no recurrence of hæmorrhage, and the cure of the child answered my expectations.

Remarks.—Hæmophilia or leucocythæmia, somewhat common diseases, are generally mortal, and resist all ordinary treatment, especially when they attack young subjects.

I have operated with similar success in other cases of constitutional hæmophilia, after all other treatment has proved ineffectual; in several cases of uterine affection with chloro-anæmia and leucæmia; and in four cases of scurvy of the utmost gravity, in which the blood had undergone such disintegration that it would flow from the slightest wound.

It is almost certain that in these cases of disease of the blood and the circulatory system the transfused blood has the effect of restoring the quality of the patient's blood, fortifying it by its solidifying fibrin, and closing the opening of the vessels to cicatrise them as they would be in the body of a healthy person, instead of permitting the blood to flow from the slightest opening, as though it were so much water.

Many women are gradually enfeebled till at last they die by losing every month far too large a quantity of blood, simply because their blood is too poor and liquid, and because their digestive organs, insufficiently strengthened by this blood, which has lost vitality, are unable to restore these losses either by food or medicines. Transfusion, which acts directly as a stimulant to the quality of the blood, is alone capable of rescuing

them from the recurrence of the mischief to which they are exposed.

OPERATION 6. *Transfusion in a case of Pulmonary Consumption.*—Bossex, Haute Savoie, near Geneva. Private practice in my home for convalescents. *Recovery.*

Patient, Miss Marie B., aged 27; parents healthy, vinegrowers, in fairly easy circumstances. I had known the woman for nearly four years, and on returning to the country treated her in the ordinary way for chronic pulmonary phthisis. She had passed through several very serious crises, which the strength of her original constitution had enabled her to survive. Menstruation at times absent, at times very abundant.

During the winter of '75, '76 she did not leave her bed, and seemed to be at the last stage of phthisis. Hæmoptysis, purulent expectorations, containing blackish *débris* of pulmonary parenchyma. Amphoric resonance, cavities at apex of left lung, induration in the right lung, erratic pains, sleeplessness, loss of appetite, nocturnal sweatings, vomitings, diarrhœa, and extreme weakness.

June 7th, 1876.—Direct transfusion of 115 grammes (4 ounces) of blood taken from a cousin of the patient, a young peasant girl in robust health.

During the operation some attacks of coughing and blackish sanguineous expectorations. For this reason I

only performed small transfusion, in order to avoid injuring the lungs. Slight cyanosis, asphyxia, and palpitation for ten or twelve minutes. No rigors, slight sweating.

Before transfusion, pulse feeble, 80; respirations 32 per minute.

During transfusion, pulse very hurried, 120; respirations 38.

One hour after transfusion, pulse full and regular, 95; respirations 30.

Three hours after, pulse full and regular, 90; respirations 28.

In evening, pulse full, 100; respirations 30.

June 8th.—Passed a restless night, disturbed at times by feelings of suffocation, accompanied by cyanosis, coughing, and expectoration of blood.

Better in morning, enjoyed a tranquil sleep, respiration more calm and full. During the day blackish expectorations of pulmonary *débris*, no blood. She took nourishment several times without vomiting, still suffered from a feeling of suffocation.

The second night was in all respects good. She slept for four hours without awaking, which was very unusual for her.

Since that time no return of blood-spitting, and at the end of five days I discovered no trace of pus or *débris* of the lungs in the expectorations; the cough was greatly diminished.

June 20th.—Respiration improved, especially in the right lung; in the left, amphoric cavernous sounds audible, without gurgling. The progress made was very marked, appetite good.

25th.—The menstruation has returned, though in a very moderate degree. She left the house and worked for some hours in the vineyard.

28th.—The patient was going on well, but, through imprudence, was caught in a shower and could not regain the house in time. In the evening she coughed considerably, was feverish, and suffered from pains in the chest. The next day but one the fever had ceased, but the phthisis seemed likely to make rapid strides. Sleeplessness, diarrhœa, purulent expectorations, gurglings in the cavities on the left, râles numerous on the right.

Treatment.—Two large blisters on each side of the chest, morphia in draught, &c.

This acute crisis lasted for ten days. She again survived it, but it left her in a state of extreme weakness. She requested a second transfusion, which I put off till all acute symptoms had disappeared.

July 22.—Second transfusion of 230 grammes (8 ounces) of blood from the same source as before. A little coughing and palpitation, expectoration of mucus, no trace of blood, rigors somewhat marked on three occasions, during the first few hours, succeeded by free perspiration. Sleep, a little disturbed, for one hour.

The effect of this second transfusion was even more considerable than the first. After eight or ten days the patient ceased coughing, except slightly in the evening and morning. There were still pulmonary *débris* and pus in the expectorations, which were less solid and contained mucus, and continued to decrease.

The appetite and strength rapidly returned, with every outward indication of health.

August 30th.—The right lung appeared healthy and free from all suspicious sound; the left still gave an amphoric breathing sound without gurgling. On percussion the extent of the cavity appeared to be diminished.

In order to avoid all dangers of a relapse by working in the vineyard with her parents, I sent the girl to a well-to-do family near Annecy, accompanied by her cousin, who, by offering her blood, had helped me to effect the cure.

In a letter dated January 1st she told me that she was completely cured, being able to work as lady's maid without feeling fatigue, for which she expresssd her warmest thanks and gratitude.

Whether the cure of this case of pulmonary phthisis will be permanent I am unable to say, but I have reason to hope so.

Remarks.—A cure, or indeed a prolonged check to the advance of pulmonary phthisis in the third stage, with a considerable and lasting amelioration of the symptoms, is certainly rare, but not altogether unexampled. One meets at times autopsies, healed lungs showing the cictarices of old cavities which have closed, and calcareous concretions of old tubercles which have disappeared. Such fortunate cases present themselves especially when the malady is not hereditary, but accidental, as in the case before us.

Under the powerful restorative action of the transfusion it may be presumed that the wounds of the

affected lungs healed in a like manner to those which may be seen every day in the case of a limb.

Vitality was restored in the organ, a dividing boundary separated the healthy tissues from the affected parts, whence the diseased portions were expelled in abundance by the expectorations of the early days, until the wound, or rather the internal surfaces of the cavities, were completely cleared, and became covered with membrane of a favorable nature which secreted the cohesive and contractile cicatrising lymph, thus diminishing the surface of the wound and producing a healthy definitive cicatrix.

The amphoric resonance without gurgling, which was detected by auscultation at the apex of the left lung, after the complete expulsion of the blackish and gangrenous *débris* of pulmonary tissues, resembles that of a simple bronchial dilatation.

This case is all the more interesting in that it may, so to speak, be regarded as double, for after the first cure effected by transfusion the malady recommenced in consequence of a new accident, only to yield once more to a vigorous treatment and a second transfusion.

OPERATION 7. *Transfusion in a case of Anæmia with melancholic dementia; Recovery.*—January 27th, 1874, *Vienna*, Algemein Krankenhause, Psychiatrie, lunatics' division, under the care of Professor Leidesdorf. *Patient*, man aged 25, a lunatic, having suffered from melancholia for several years. Has become anæsthetic

and cataleptic; his limbs retain for any length of time the position which one chooses to give them, as if they were the limbs of a puppet. Eyes, closed or fixed, insensible to the light, and vacant; absolutely dull to all external sensations, neither saw, heard, answered questions, nor moved.

For the last six months he had not pronounced a single word or left his bed. As he did not swallow food which was forced down his throat; in short, he had reached such a state of general exhaustion that there was no hope of effecting a cure.

The pulse was very feeble and slow—between 35 and 40 the minute.

His mother, who was consulted before attempting the transfusion, accepted the proposition very readily, saying she would sooner hear her son were dead than that he should remain in such a sad condition, which was no longer life.

Professor Neudörfer prepared the vein, which was much contracted and very difficult to distinguish. The patient did not even open his eyes nor move. He was absolutely insensible to the pain of the incision. A soldier of the garrison supplied the blood.

January 27th.—I performed an easy and slow transfusion of 300 grammes (11 ounces). They readily perceived the blood swelling the vein as far as the arm-pit, as though pulsating at each pressure of the baloon-pump of the transfuser. I assisted the course of the blood, pressing it up the whole length of the arm.

Before transfusion, pulse 40 to 45. Respiration 16 to 20 per minute. Temperature 35° Centigrade.

learnt my method of operating, and only possessing a bad counterfeit of my transfuser, of which it is impossible to make good use, practised the transfusion of sheep's blood on their lunatic patients.

As is always the case with blood taken from a species foreign to man, the result was in many cases disastrous, and at last they were obliged to make transfusions of four, five, eight, and fifteen grammes only of sheep's blood, which they repeated several times on the same subject with more or less lasting success in some cases, but never obtaining the results which 300 grammes of human blood transfused all at once have secured to my own operations.

This form of mental disease accompanied by stupor is somewhat frequent among young persons.

Such cases are numerous in England.

Relying on the favorable result of this operation, I have been led with all confidénce to request the leading physicians of the lunatic asylums of London to make trial of transfusion in cases of melancholia.

Operation 8 (from the 'Lancet' and the 'British Medical Journal'). *Transfusion in a Case of long-standing Dementia with Anæmia.—London, Bethlehem Hospital,* 22nd December, 1876, under the care of Dr Rhys Williams, and reported by him.

Patient T. F—, aged 20, clerk, was admitted into Bethlehem Hospital on April 22nd, 1876, having suffered from symptoms of mental disease (melancholia

with delusions) for about seven months. There was no history of neurosis or intemperance, and reverse of fortune was given as the cause of the attack. According to the statement of his medical attendant he had practised onanism to a great extent.

December 21st.—He was in a state of dementia and catalepsia, would stand in one position for hours with his chin upon his breast and his eyes shut. He would not readily answer questions, and then in a very low tone of voice, and does not respond to external impressions.

He was dirty in his habits, probably in consequence of his mental condition rather than of any loss of power over the sphincters. His mouth kept half open and trembling, his saliva dribbled, his fingers were clenched over his thumbs, all the joints half flexed. His general health was bad; he required to be fed with a spoon forcibly.

Very anæmic, tall, thin, pale, and shows a small beard. His weight was six stone twelve ounces.

There was suspicion of lung mischief, but, as usual in such cases, the symptoms were masked. There was slight flattening under the right clavicle.

Temperature 101° Fahrenheit; respirations 25 to 29 per minute; pulse very feeble, 70 to 80.

After consultation with Dr Bucknill, Dr Hack-Tuke, and Dr Roussel, the case appeared to Dr Rhys Williams, physician to the hospital, a fair one on which to try the experiment of transfusion, as it resembled in many points the one operated on successfully by Dr Roussel in Vienna.

In this opinion Dr Bucknill concurred, stating that

if any result, however slight, could be obtained in such a case, great hopes might be entertained for cases of less gravity which are very common in England.

December 22nd, 3 p.m.—The operation was very skilfully performed by Dr Roussel, and blood to the amount of ten ounces was transfused, Mr Cockell, of St Thomas's Hospital, generously supplying it.

During the opening of the vein, a proceeding which was rather protracted, the vein being small, as it commonly is in old cases of anæmia, the patient did not open his eyes; moreover, as the blood passed slowly, Dr Fancourt Barnes, who acted as assistant in the operation, helped it along the vein by pressing up towards the deltoid. As this was done at each pressure of the transfuser's ball, the veins were seen to swell up with the transfused blood.

It was not before the ball had been twice emptied that the patient showed some colour in the face; respiration became more marked and rapid, with a slight attempt at a cough.

He received 260 grammes of blood without showing any bad symptoms; he even gave evidence of being roused from his habitual torpor. Pulse 106, full; respirations 30.

Immediately after the operation he was placed in a warm bed; tea and brandy were administered to lessen the rigors, which Dr Roussel expected to be more marked than usual in so anæmic a patient.

5.30 p.m.—The pulse was full, 100; temperature 103° Fahrenheit; respirations 28.

Answered to his name; said, "I want to sleep. I have no pain;" rubbed his face with his left hand,

could put out his tongue, and endeavoured to open his eyes when told to do so. He took food freely and swallowed voluntarily, fed with a spoon. Dr Rhys Williams and the attendant said it was the first time he had answered questions.

He was sweating very profusely.

10 p.m.—Pulse 104; temperature 104° Fahrenheit; respirations 40. There had been very slight hæmoptysis, which only lasted a short time. He was breathing fairly. There had been three attacks of rigors, but he was now sweating profusely. He took food well when fed.

December 23rd.—Pulse 96; respirations 28; temperature 100° Fahrenheit; gentle perspirations and moderate warmth, no pains. Passed a good stool, and the urine, though high coloured, was clear, without albumen or blood. He had taken plenty of beef tea, milk, &c.

At 4 p.m.—Pulse 90, respirations 28, spoke and answered slowly when spoken to. Said he had no pain. Lungs and other viscera healthy. The arm operated on shows no trace of swelling, redness, or pain, or of secondary bleeding from the wound. Dr Roussel requested that he might be well fed, and repeatedly roused.

24th.—Pulse 94, temperature 99°, respirations 30, nourishment administered very freely.

25th.—Respirations were clear, there was no dulness or moist sounds.

26th.—Was very well; pulse 80; respirations 26.

4 p.m.—Ate and drank well, urine normal, spoke and answered slowly. Dr Roussel wished him to be

got up to-morrow. Since the operation he had been visited by Dr Buckuill, and Dr Rhys Williams had resolved to have the transfusion repeated, the result being so encouraging.

27th.—He got up to-day. Pulse 80, temperature 99°, respirations 28.

1877, January 8th.—His general health had slightly improved, he had increased six pounds in weight. There was no special mental change.

Dr Rhys Williams observes: "I have no reason to regret the result of this experiment; but whether transfusion is clearly indicated in cases of long-standing anæmia is, in my opinion, an open question. *Dr Roussel has added one more link to his chain of proofs that, when performed with his most admirable instrument, the operation is a safe one.* I cannot deny that for the first days the patient, to a certain extent, did respond more readily to external impressions, but the constant rousings, and the incessant attention paid him, may fairly claim some share of the credit in the result.

"Dr Roussel wishes to repeat the operation as soon as possible, so as not to lose the good already effected by the first transfusion. He has great confidence that the cure of this interesting case of lunacy may be completed by repeating this useful operation, to which no danger attaches, several times if necessary."

At St Luke's Hospital for Lunatics I commenced the cure of a malady of the same kind. A first transfusion only amounted to 50 or 60 grammes (two ounces), owing to a circumstance beyond my control. The physicians of the hospital, nevertheless, remarked a

certain improvement, though slight, in the general condition of the lunatic. This is a case for the continuation of the treatment.

Remarks.—This transfusion in a case of mental disease, coupled with anæmia of the brain and of the entire body, had not led to so complete and rapid a success as the operation at Vienna. Nevertheless, I consider the results of the operation satisfactory, since, without exposing the patient to any danger, it has temporarily, it is true, improved his mental condition, and, in a very evident manner, his general health. Moreover, I have never asserted that a single transfusion is always sufficient to cure a similar chronic state of anæmia of the brain and the whole body. I consider, on the contrary, that a general affection which has come on slowly and by progressive stages can in most cases only be cured slowly and progressively by repeated transfusions.

I am quite ready to continue the treatment commenced at Bethlehem and St Luke's Hospitals. I trust that the zeal of those physicians will not flag, and that I shall be enabled, not only to repeat those operations, but also to find similar cases, for they are very numerous in the homes and in the hospitals of London, and England generally.

Dr Bucknill, the celebrated authority on this subject, whose practical experience has been so real and so protracted, said to me previously:—"If you obtain the slightest change for the better in the case of this subject by transfusion, we shall be able to repose great confidence in this mode of treatment, for it is extremely

seldom that we can, by the known methods of treatment, improve the condition of these lunatics, who refuse to take nourishment. However much trouble we take to feed them with the spoon or the stomach pump, they scarcely ever survive more than one year or a year and a half, and succumb to gradual exhaustion."

TABLE

OF FIFTY DIRECT TRANSFUSIONS

Performed by Dr J. ROUSSEL

From 1865 to 1877.

Subjects, 37 men, 12 women, and 1 child.

Results, 26 complete recoveries; 14 partial successes; 10 unsuccessful, in every case after some amelioration.

All these were cases of extreme urgency, or after all other means had failed. Death in no case caused by the transfusion itself.

Diseases necessitating these transfusions.

Duration of survival after the transfusion.

Doses of blood transfused, in grammes and English ounces.

Followed by three experimental transfusions; one on the cadaver, electric transfusion; two, transfusions of sheep's blood.

A. *Acute Hæmorrhages*

Wounds on the field of battle, and surgical wounds, 7 cases—6 men, 1 woman.

Four complete successes, with 210 grammes (7½ ounces); 250 grammes (9 ounces); 226 grammes (8 ounces); 280 grammes (10 ounces).

One partial success. Amputation of breast; 200 grammes (7 ounces); cure of anæmia.

Secondary hæmorrhage from rupture of the ligature of the subclavian artery 10 days after.

Two unsuccessful.

Disarticulation of the thigh, 160 grammes (6 ounces); death six hours after.

Resection of knee-joint, tetanus, 120 grammes (almost 4 ounces); tetanus ceased, and returned after 17 hours—death.

Puerperal hæmorrhage, 4 cases.

Three complete successes, 310 grammes (11 ounces); 250 grammes (9 ounces); 260 grammes (9 ounces almost).

One partial success; 200 grammes (7 ounces); anæmia cured; peritonitis and death 9 days after.

B. *Chronic Hæmorrhage*

Hæmophilia, 3 cases, men.

Two complete successes; 300 grammes (10½ ounces; 250 grammes (9 ounces).

One unsuccessful. Hæmophilia, with tubercle, 180 grammes (6½ ounces); death at the end of 7 days.

Uterine hæmorrhage, 2 cases.

Two complete successes; 120 grammes (4½ ounces); 200 grammes (7 ounces).

Intestinal hæmorrhage, 1 case, man.

One complete success; 300 grammes (10½ ounces).

Stomachal hæmorrhage, 2 cases, men.

One complete success; 200 grammes (11 ounces); simple ulcer.

One partial success; 120 grammes (4½ ounces); cancerous ulcer; death 3 months after.

C. *Anæmia without Hæmorrhage*

Acute chloro-anæmia, 2 cases, women.

Two complete successes; 260 grammes (9 ounces), 160 grammes (6 ounces).

Anæmia, inanition from tumour obstructing œsophagus, 1 case, man; partial success; 200 grammes (7 ounces); cure of anæmia; tumour persistent.

Anæmia, dementia; melancholia, 3 cases, men.

One complete success; 310 grammes (11 ounces); anæmia and dementia cured.

One transient success; 200 grammes (7 ounces); improvement of the anæmia; mental condition returned after a marked amelioration of five days; operation should be repeated.

One incomplete operation; 60 grammes (2 ounces); slight amelioration; operation should be repeated next.

Anæmia, inanition; dementia; general paralysis; 2 cases, 1 man, 1 woman.

Two partial successes; 180 grammes (6½ ounces) and 160 grammes (5½ ounces); amelioration of anæmia; general condition the same.

Anæmia after scurvy, 3 cases, men.

Two complete successes; 250 grammes (9 ounces); 300 grammes (10½ ounces).

One transient success; 200 grammes (7 ounces); death after 1 month.

Anæmia after remittent fevers or typhoid, 6 cases, 4 men, 1 woman, 1 child.

Two complete successes; 160 grammes (6 ounces); 260 grammes (9 ounces).

One transient success; 180 grammes (6½ ounces); death after 8 days.

Two unsuccessful; 140 grammes (5 ounces); death after 2 days. Child, aged 1 year; 60 grammes (2 ounces); death after 6 hours.

Anæmia after prolonged suppuration, 5 cases, men. Three complete successes; 220 grammes (7⅓ ounces), 240 grammes (8⅓ ounces); and 500 grammes (18 ounces), in two transfusions.

Two transient successes; 120 grammes (4½ ounces), death after 1 month; 200 grammes (7 ounces), death in 15 days.

D. *Various Indications*

Acute septicæmia, 3 cases, men.

One partial success; 200 grammes (7 ounces); death after 14 days.

Two unsuccessful; 300 grammes (10½ ounces), death after 5 days; and 60 grammes (2 ounces), death after 2 days.

Tuberculosis, 1 case, woman.

Complete success in two transfusions; 115 grammes (4 ounces), and 230 grammes (8 ounces).

Asphyxia, two cases, men; free bleeding before the transfusion.

Two complete successes; oxide of carbon 310 grammes (11 ounces). Drowning; 220 grammes (8 ounces).

Algide cholera, last stage, 2 cases, men.

One incomplete success; 260 grammes (9 ounces) blood, and 200 grammes (7 ounces) water; cessation of the cholera; death after 17 hours.

One unsuccessful; 150 grammes (5½ ounces) blood, 60 grammes (2 ounces) water; death after 5 hours.

Extensive burn of the skin, weak and poisoned blood, 1 case, woman; transient success; 150 grammes (5½ ounces); amelioration for 7 days; second transfusion; 120 grammes (4½ ounces); death sudden in a bath 3 days after.

Acute farcy, general gangrene, 1 case, man.

Unsuccessful; 225 grammes (8 ounces); death in 17 days.

E. *Experimental Transfusions*

Wounds in war, death by explosion of dynamite, various wounds bleeding; ten minutes after death transfusion of 250 grammes (9 ounces) of blood, with electric current in the apparatus, the electricity makes the heart beat, and the blood passes through it.

Congenital Idiocy, contractions, anæmia, 1 case, woman. 60 grammes (2 ounces) of *sheep's venous* blood, slight excitement, no result, no change in general condition.

General scrofulous suppuration and inflammation of psoas muscle, caries of iliac bones, agony. 1 case, man. 240 grammes (8½ ounces) from *sheep's artery*; marked excitement, return to consciousness, death after 14 hours.

Transfusion of blood is an operation of English origin; it should preserve its nationality by making rapid strides in its native land.

I feel that I could do much towards its development if I had the opportunity of treating personal patients. For ensuring success, however, it is absolutely necessary that the patient operated on by myself should remain solely under my supervision, till the cure be completed.

Meanwhile I should be both willing and anxious to perform the operation of direct transfusion whenever called upon by my colleagues, also to afford any assistance or instruction in my power for the public good, and to further the development and extend the advantages of so great a boon to suffering humanity.

PROF. J. ROUSSEL, D.M.

LONDON; 23, Gloucester Place,
Hyde Park.

P.S.—I have successively shown my Transfuser, and performed the operation of transfusion, in the Academies and schools of medicine, civil and military, of Prussia, Austria, France, Belgium, and England. Everywhere it has been carefully examined by com-

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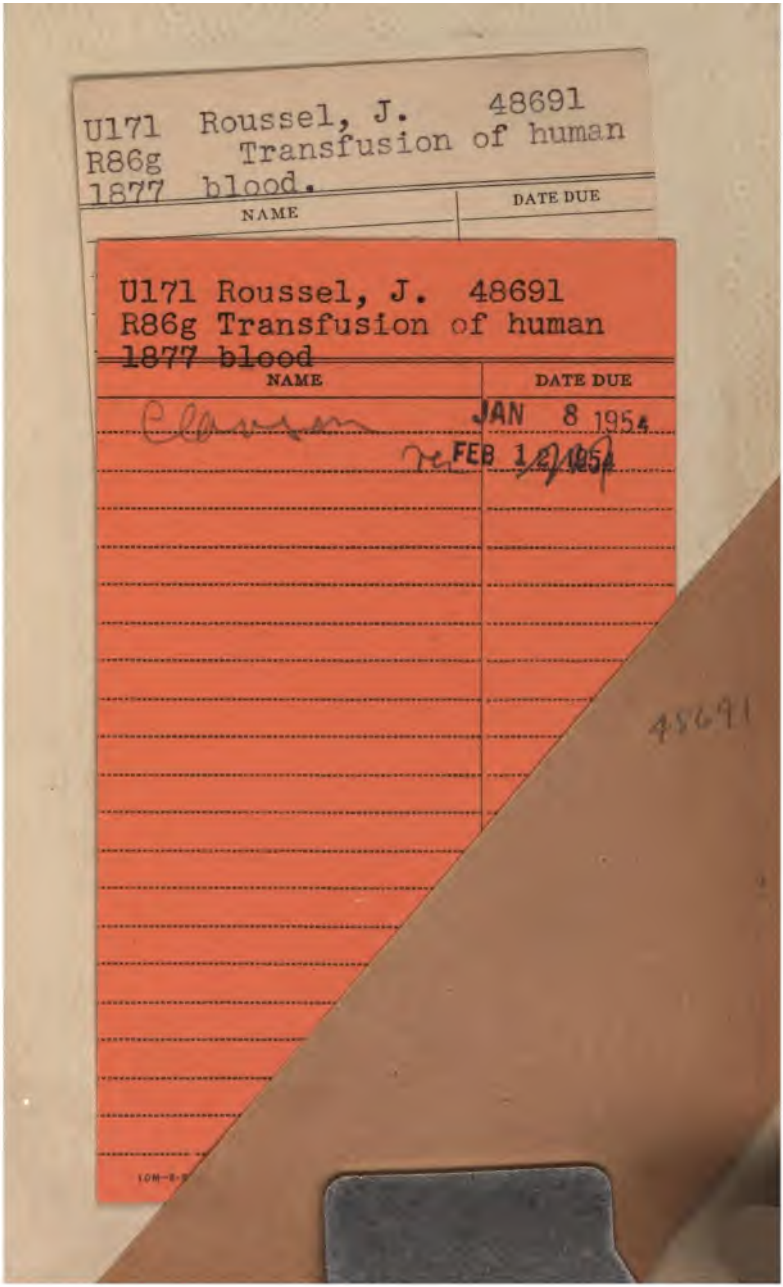

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